Test Report

Airtightness test of the spray-applied airtightness system "PASSIVE PURPLE EXTERNAL"

Manufacturer:

Intelligent Membranes Ltd.,

Clopton Farm, Lower Road, Croydon,

SG80EF Cambridgeshire, United Kingdom.

Airtightness system: Surface sealing

Darmstadt: 04.10.2024

Passive House Institute
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Commissioned by:	Intelligent Membranes Ltd., Clopton Farm, Lower Road, Croydon, SG8 0EF Cambridgeshire, United Kingdom.
Product:	**Airtightness system consisting of** PASSIVE PURPLE EXTERNAL
Product name:	PASSIVE PURPLE EXTERNAL
Tested size:	Product spray-applied as per manufacturer's instructions

1. Introduction

Airtightness across the surface is a central prerequisite for an effective airtightness concept. A good level of airtightness of the building envelope is an essential element for its overall functioning, particularly in energy efficient buildings. This investigation, within the framework of certification as a passive house component, took place under the most realistic possible boundary conditions in order to ensure that the tested products function in the installed state. In particular, the connection of the tested system to typical adjacent materials has been examined. With respect to the product system, the tests examined the connection with membranes, concrete, and hard engineered wood panels (here: OSB).

2. Criteria

The values specified for PH certification of surface sealing can be taken from Table 1 below:

Class	**Air permeability based on area** @ 50 Pa [$m^3/(hm^2)$]
ph**A**	≤ 0.10
ph**B**	≤ 0.18
ph**C**	≤ 0.25

Table 1: Requirement classes for the certification of surface sealing products according to Passive House Institute specifications

These apply to the overall performance of a product system specified by the client, consisting of several components.

In addition, comprehensible guidelines/instructions for use must be provided for installation of the product, on which the test setup will be based. These must be made available to all users.

Testing of moisture permeability and the characteristic values for moisture for different ambient humidity levels do not constitute part of this test.

3. Materials to be tested

For surfaces, the spray-applied sealing product PASSIVE PURPLE EXTERNAL is applied. Its primary use is on massive substrates. Connections to adjacent airtightness systems of a different type were made in the following ways:

- Connections to adjacent solid building elements (concrete) and to hard wood-based panels (OSB) are sprayed over with the same material.

- Connection to an airtight membrane, glued to the substrate, is sprayed over with the same material.

The following products were delivered by the client on 14.08.2024:

- PASSIVE PURPLE EXTERNAL (Spay, 10kg pails)
- Graco ST Max II/595 PC Pro airless sprayer, 517 tip

4. Setup for the system and connections

The sealing system was spray-applied in overlapping passes onto an air-permeable glass fibre substrate and allowed to cure. A second coat was added and left to cure.

For the connection to OSB or concrete, an inset panel was placed into the centre of the substrate and the circumferential joint taped over. Then the joint was sprayed over with the product.

Samples were placed on the test rig. For sealing, a frame that was identical in construction to the sub-frame of the test apparatus was placed on the apparatus. The frame and counter frames were each equipped with a 5 cm wide sealing surface, which served as a support for the test sample. The counter frame was tightened to a defined torque using screws and a torque wrench. Tension-free and uniform installation in the test stand was possible due to the even pressure of the counter frame.

Each test setup (membrane to membrane, membrane to OSB, and membrane to concrete) was created and tested three times in order to minimize any influences by workmanship.

4.1 Regular Surface

The samples for the regular surface were made and tested as a reference only.

4.2 Membrane to membrane

To test the connection of areas sealed with the product to areas sealed with airtightness membranes, an exemplary certified membrane inset was placed into the

centre of the substrate. A seamless connection to the surface seal was created by spraying PASSIVE PURPLE EXTERNAL over the membrane.

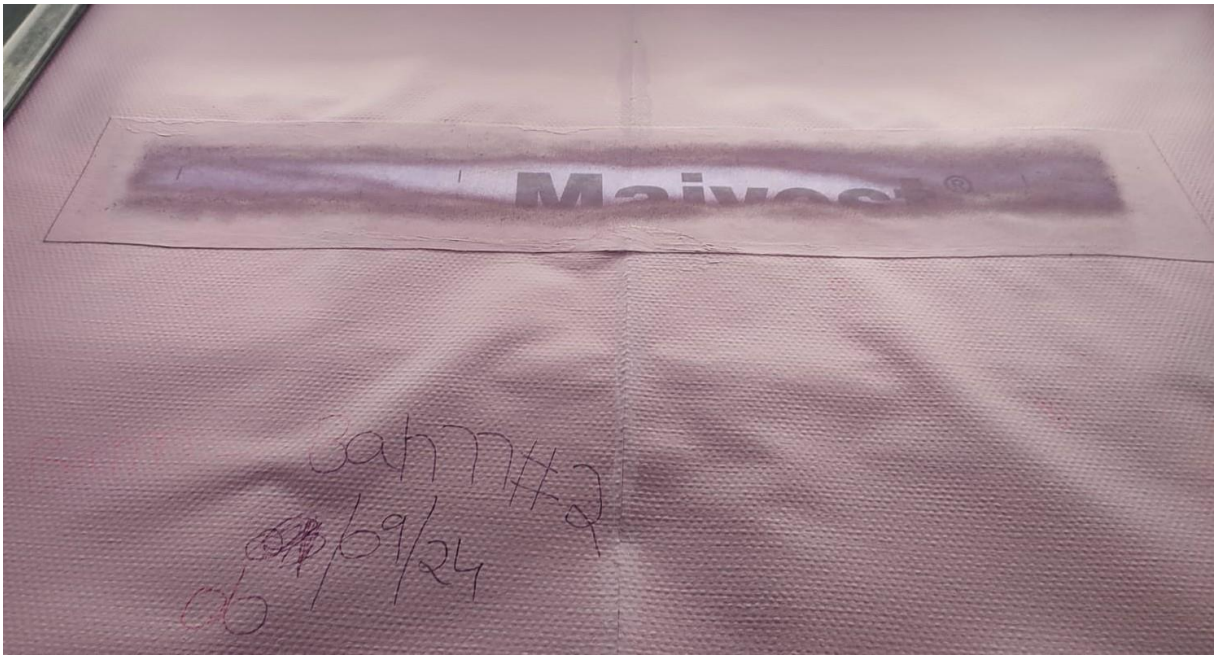

Fig. 1: Connection to a membrane-based air sealing system.

4.3 Membrane to concrete

The connection to concrete components was prepared according to the manufacturer's instructions. For this purpose, a concrete inset panel was placed at the centre of the substrate. The resulting gap was taped and sprayed over with the product.

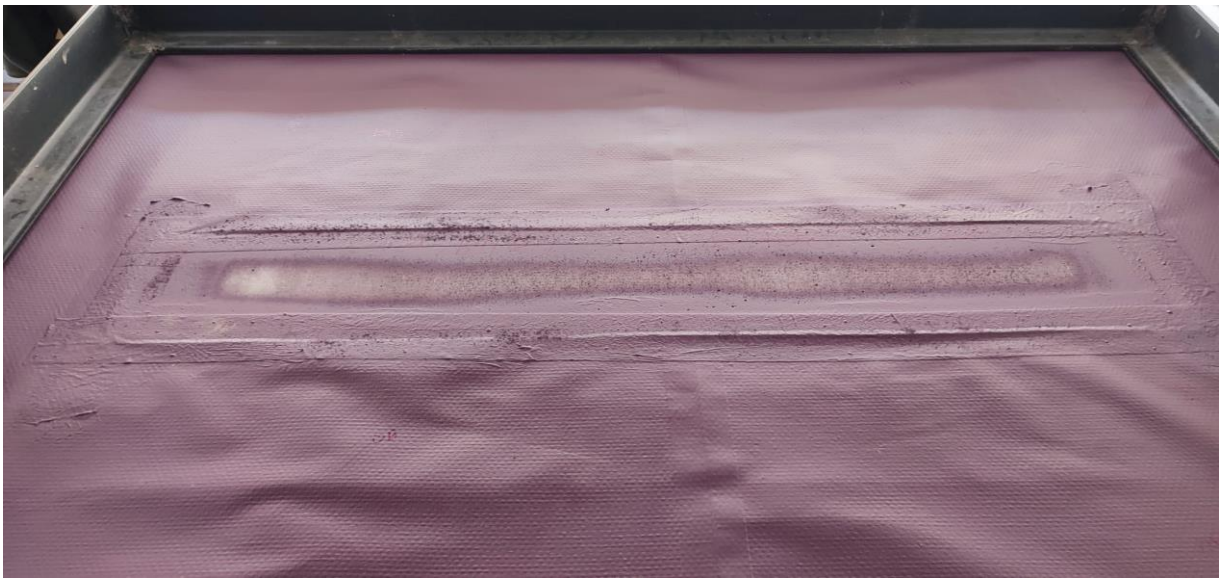

Fig. 2: Testing the joint with a concrete member

4.4 Membrane to OSB panel

The connection to wooden board components was prepared according to the manufacturer's instructions. For this purpose, an OSB inset panel was placed at the centre of the substrate. The resulting gap was taped and sprayed over with the product.

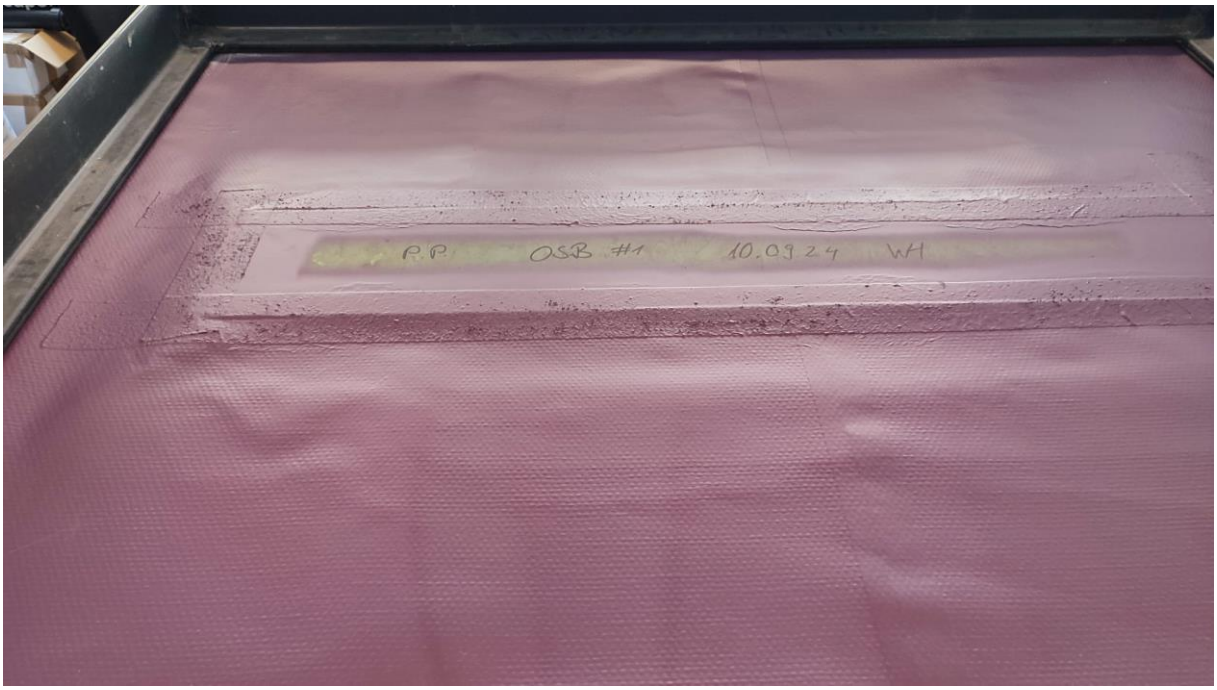

Fig 3: Testing the joint with a wooden board member

5. Test procedure

After setting up in the test stand and attaching the sample, a measurement was carried out in following DIN EN 12114. For this measurement, the following pressure stages were set for positive and negative pressure: 50, 100, 150, 200, 250, 300, 350 Pa. First, the residual leakage of the test stand for all pressure stages was measured and documented for each measurement (reference measurement). For this, the test apparatus was closed using an airtight board. The leakage of the test stand thus determined was deducted from the result of the measurement afterwards.

In each measurement, the conveyed volume flow was measured and recorded for each individual pressure difference. With these pairs of measured values, it was possible to calculate the leakage coefficient ***C*** in accordance with DIN EN 12114 Appendix B.

From the two series of reference measurements and the two series of actual measurements, smoothing functions were determined through a regression analysis. After deducting the leakage of the test stand itself (reference measurement), the leakage flow was determined for the reference pressure difference of 50 Pa as an average value of the results from the series of negative and positive pressure measurements. This value was divided by the sample area in order to obtain the specific leakage flow per square metre. The effective area of the sample is 1.72 m² or 1.48 m² with deduction of the inset.

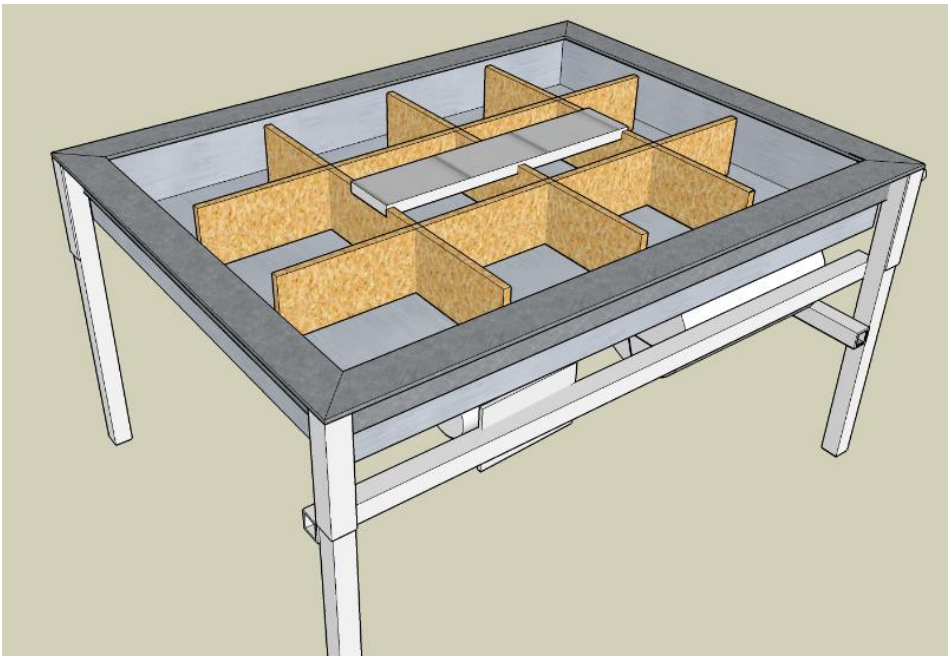

Fig 4: Sketch of the test apparatus with a fixture for the respective panels

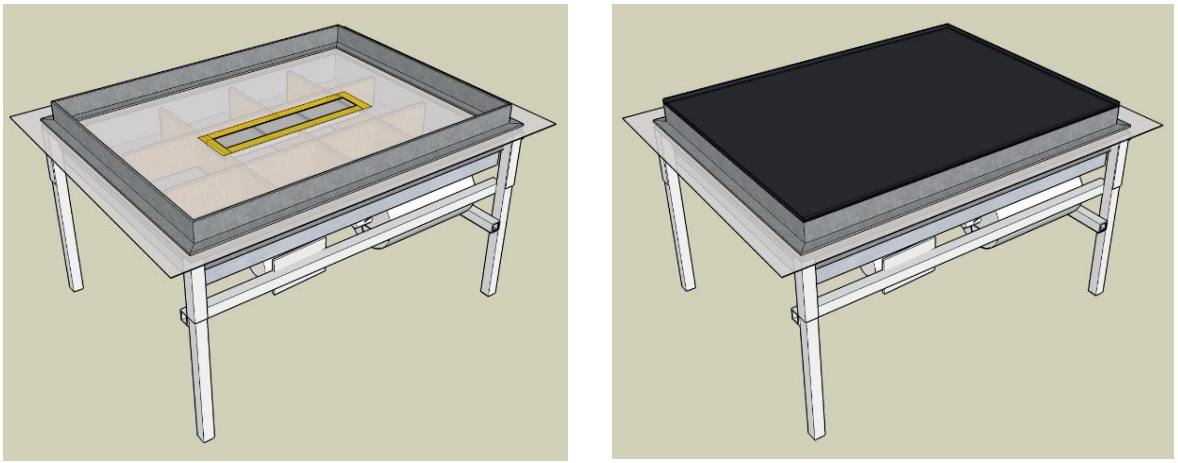

Fig 5: Sketch of the test apparatus with the clamped membrane and inserted panel which is joined to the membrane with adhesive tape (yellow) (left).
Test apparatus sealed with the cover panel for determining the test stand leakage (right).

The measurements of the examined airtightness system took place in the time period from 27.08.2024 to 27.09.2024.

6. Test results

The test results are shown in the following tables and figures, sorted according to the connection methods. The requirement classes for the certification of surface sealing systems are additionally entered in the diagrams.

In the following diagrams with a double logarithmic axis scale, some of the measured values that were determined are not recognizable because these are less than the smallest depicted y-axis value.

6.1 Membrane to membrane

Connection to	
Membrane on its own	
Membrane to membrane	x
Membrane to OSB	
Membrane to concrete	

Table 2: Test results of the three measurements with connection to membrane

examined area	1,48 m²

Pressure stages	Pa	50	100	150	200	250	300	350
Product to membrane #1								
total volume flow	m³/h	0,06	0,20	0,23	0,26	0,28	0,29	0,31
test stand leakage	m³/h	0,05	0,18	0,21	0,22	0,24	0,25	0,26
specific air volume flow	m³/h	0,01	0,02	0,02	0,03	0,03	0,04	0,04
leakage volume flow based on area	m³/(h m²)	0,01	0,01	0,02	0,02	0,02	0,03	0,03
Product to membrane # 2								
total volume flow	m³/h	0,54	1,01	1,31	1,58	1,83	2,06	2,28
test stand leakage	m³/h	0,05	0,18	0,20	0,21	0,23	0,24	0,25
specific air volume flow	m³/h	0,50	0,83	1,11	1,37	1,61	1,83	2,05
leakage volume flow based on area	m³/(h m²)	0,34	0,56	0,75	0,93	1,09	1,24	1,39
Product to membrane # 3								
total volume flow	m³/h	0,26	0,51	0,62	0,71	0,79	0,87	0,94
test stand leakage	m³/h	0,00	0,14	0,17	0,19	0,22	0,24	0,26
specific air volume flow	m³/h	0,27	0,37	0,45	0,52	0,58	0,63	0,68
leakage volume flow based on area	m³/(h m²)	0,18	0,25	0,31	0,35	0,39	0,43	0,46

Average

Q50 (PHI - assessment) **0,18** m³/(h m²)

resulting in an airtightness class of **B** according to PHI Q50 ≤ 0,18

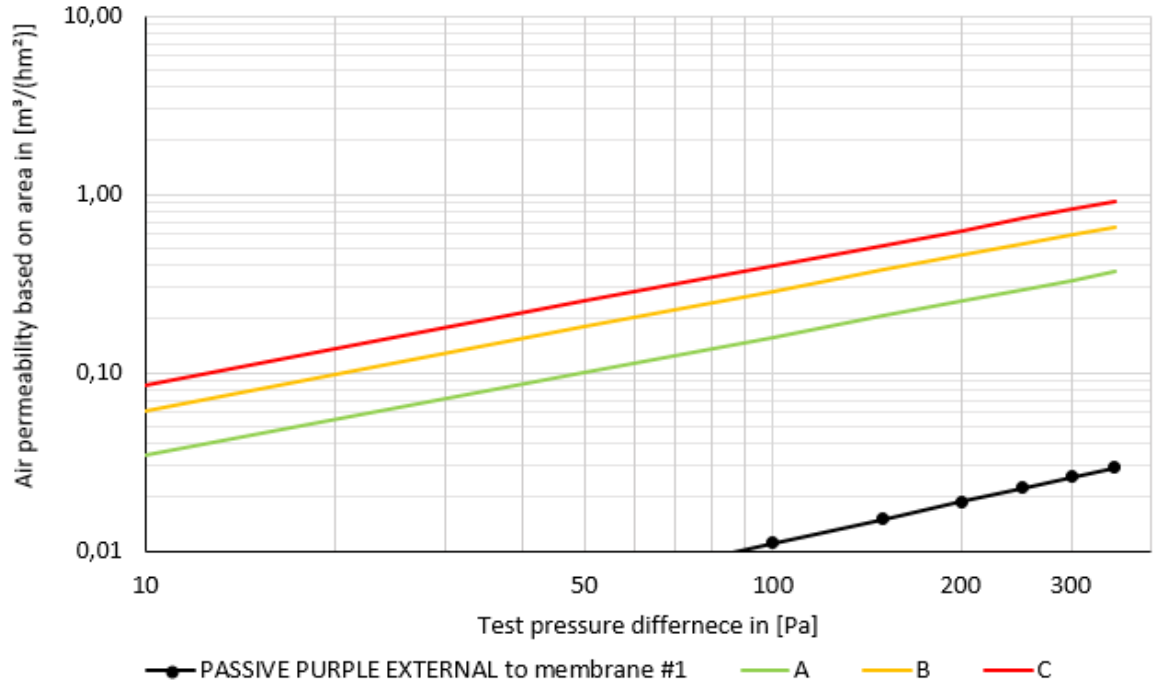

Fig 6: Series of measurements for the sample "PASSIVE PURPLE EXTERNAL" to membrane #1". The Certification Classes A to C according to the PHI are entered in addition.

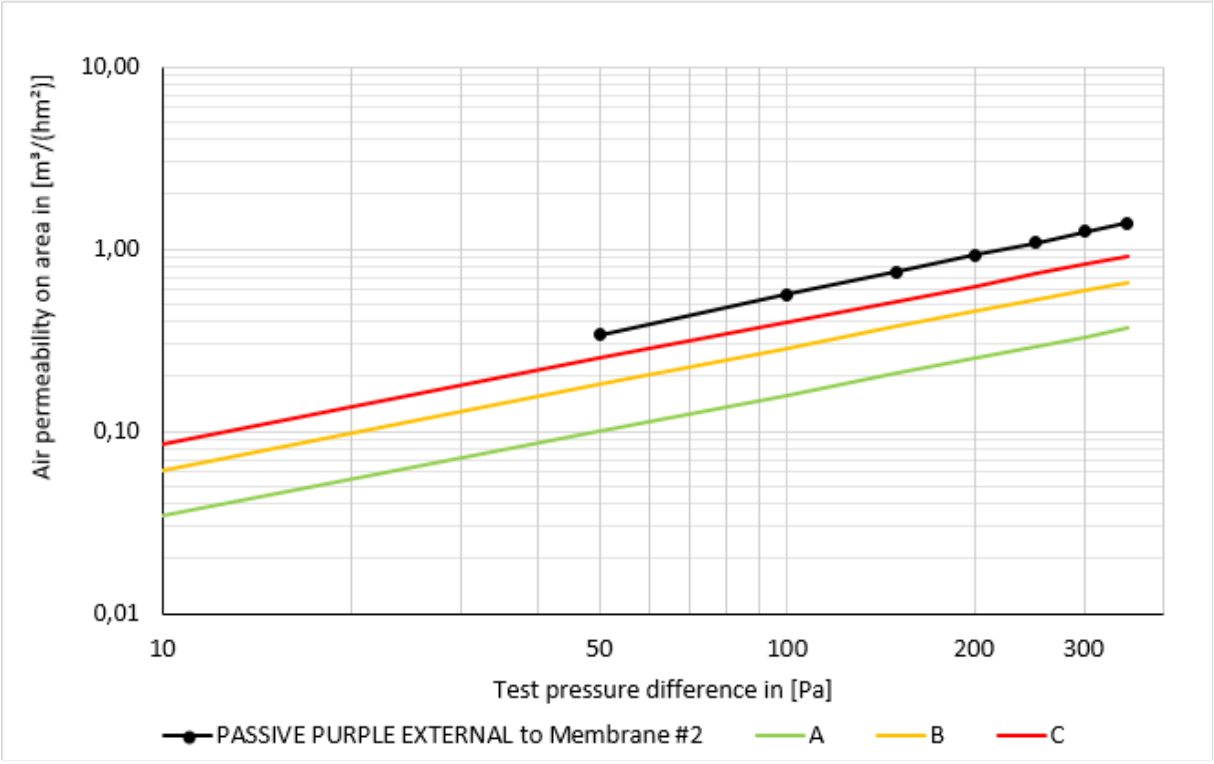

Fig 7: Series of measurements for the sample "PASSIVE PURPLE EXTERNAL" to membrane #2". The Certification Classes A to C according to the PHI are entered in addition.

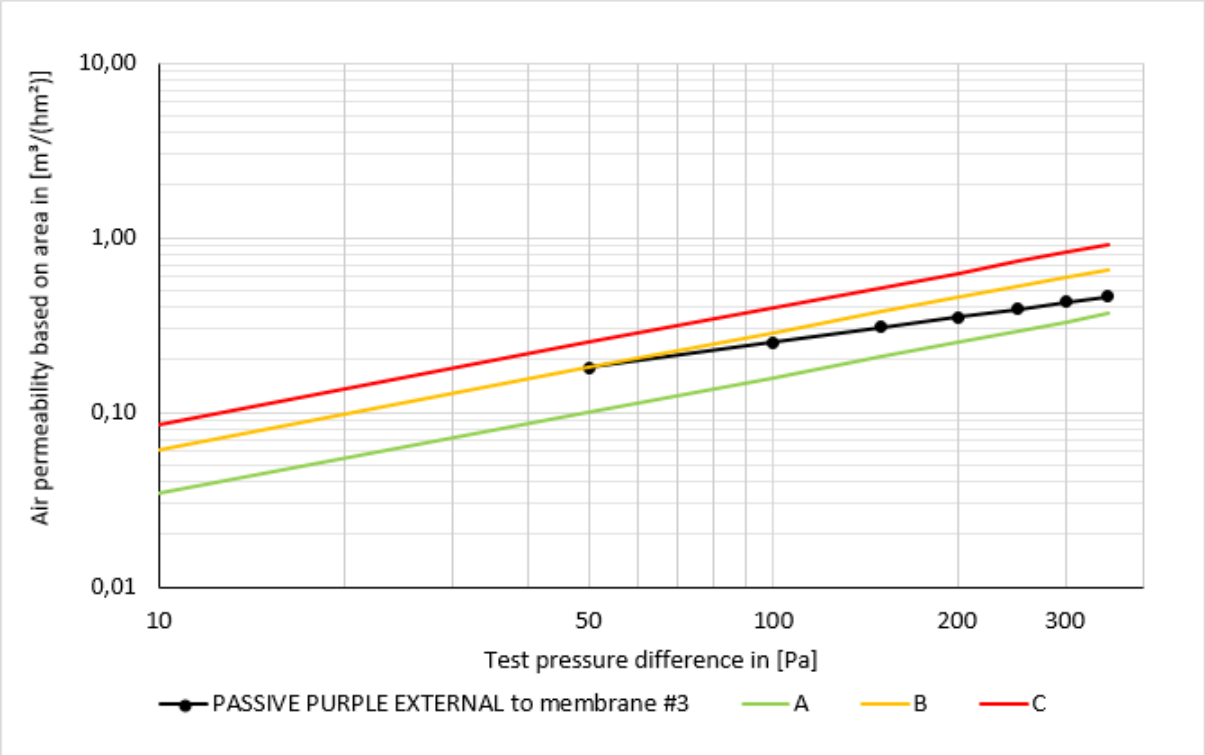

Fig 8: Series of measurements for the sample "PASSIVE PURPLE EXTERNAL" to membrane #3" The Certification Classes A to C according to the PHI are entered in addition.

6.2 Membrane to OSB

Connection to	
Membrane on its own	
Membrane to membrane	
Membrane to OSB	x
Membrane to concrete	

Table 3: Test results of the three measurements with the membrane joined to the OSB

examined area	1,48 m²

Pressure stages	Pa	50	100	150	200	250	300	350
Product to OSB #1								
total volume flow	m³/h	0,00	0,14	0,17	0,19	0,21	0,23	0,24
test stand leakage	m³/h	0,01	0,15	0,19	0,21	0,24	0,26	0,28
specific air volume flow	m³/h	0,00	0,01	0,01	0,01	0,01	0,01	0,02
leakage volume flow based on area	m³/(h m²)	0,00	0,00	0,01	0,01	0,01	0,01	0,01
Product to OSB #2								
total volume flow	m³/h	0,28	0,55	0,68	0,80	0,90	0,99	1,07
test stand leakage	m³/h	0,00	0,12	0,15	0,17	0,19	0,21	0,22
specific air volume flow	m³/h	0,29	0,42	0,53	0,62	0,71	0,78	0,85
leakage volume flow based on area	m³/(h m²)	0,20	0,29	0,36	0,42	0,48	0,53	0,58
Product to OSB #3								
total volume flow	m³/h	0,28	0,51	0,61	0,70	0,77	0,84	0,90
test stand leakage	m³/h	0,06	0,19	0,22	0,24	0,25	0,27	0,28
specific air volume flow	m³/h	0,23	0,33	0,41	0,47	0,53	0,59	0,64
leakage volume flow based on area	m³/(h m²)	0,15	0,22	0,28	0,32	0,36	0,40	0,43

Average

Q50 (PHI - assessment) **0,12** m³/(h m²)

resulting in an airtightness class of **B** according to PHI Q50 ≤ 0,18

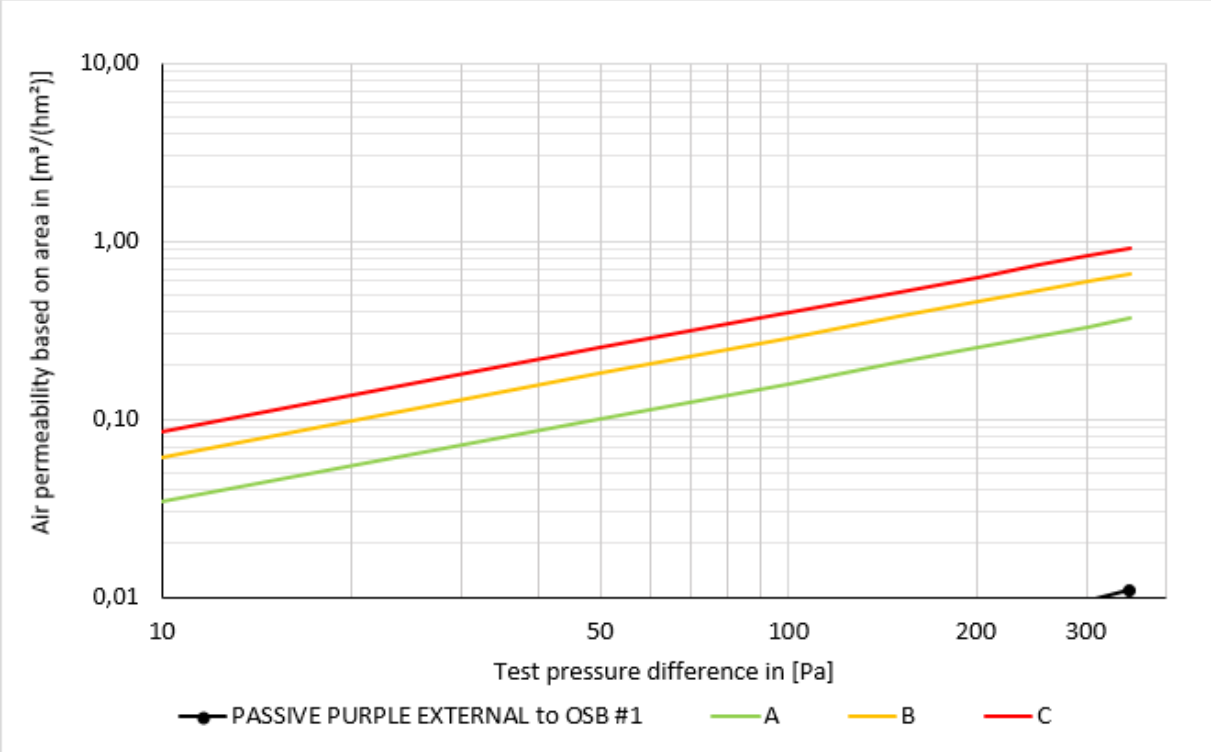

Fig 9: Series of measurements for the sample "PASSIVE PURPLE EXTERNAL to OSB #1". The Certification Classes A to C according to the PHI are entered in addition.

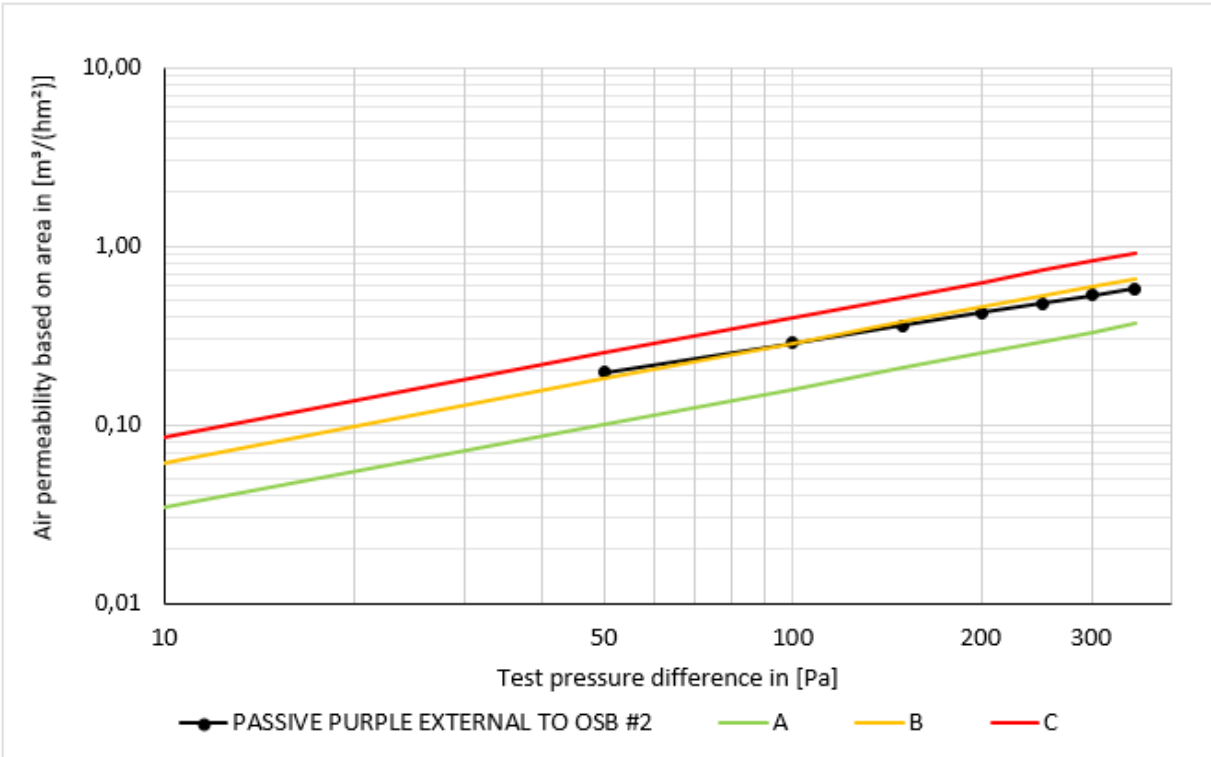

Fig 10: Series of measurements for the sample "PASSIVE PURPLE EXTERNAL to OSB #2". The Certification Classes A to C according to the PHI are entered in addition.

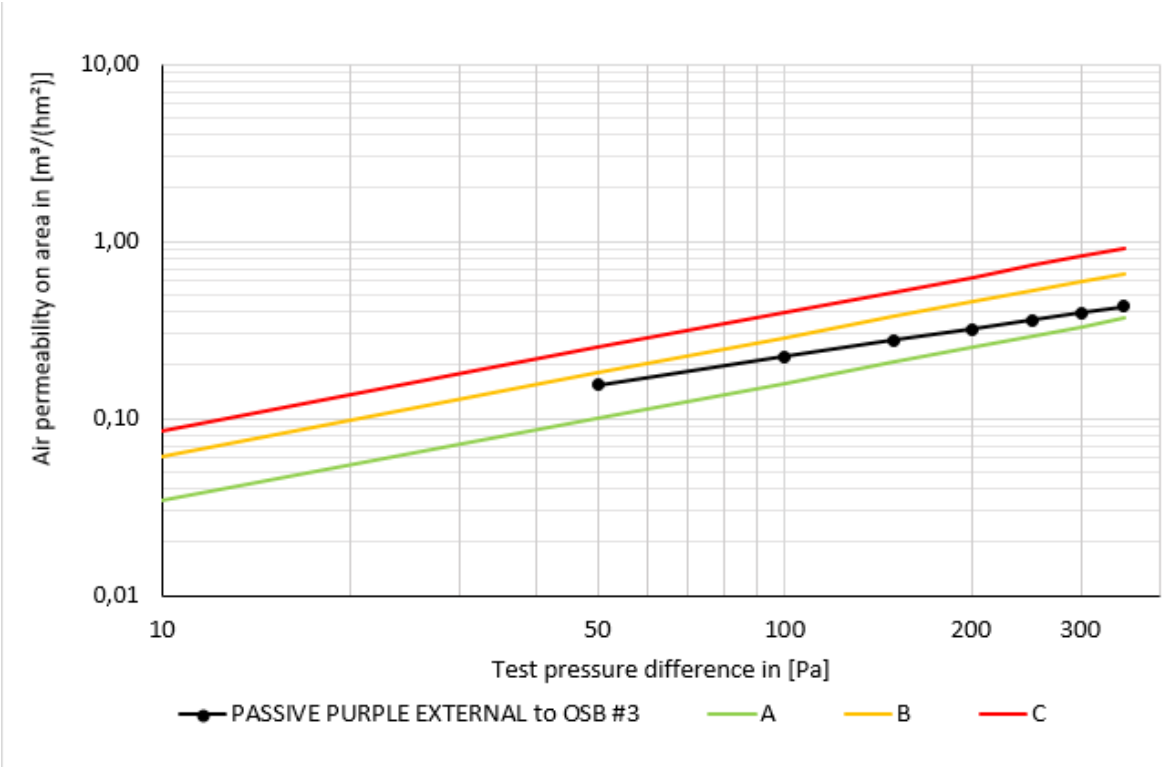

Fig 11: Series of measurements for the sample "PASSIVE PURPLE EXTERNAL to OSB #3". The Certification Classes A to C according to the PHI are entered in addition.

6.3 Membrane to concrete

Connection to	
Membrane on its own	
Membrane to membrane	
Membrane to OSB	
Membrane to concrete	x

Table 4: Test results of the three measurements with the membrane joined to concrete

examined area	1,48 m²

Pressure stages	Pa	50	100	150	200	250	300	350
Product to Concrete #1								
total volume flow	m³/h	0,73	1,18	1,45	1,67	1,87	2,05	2,22
test stand leakage	m³/h	0,06	0,20	0,23	0,25	0,27	0,29	0,30
specific air volume flow	m³/h	0,67	0,98	1,22	1,42	1,60	1,77	1,92
leakage volume flow based on area	m³/(h m²)	0,46	0,66	0,82	0,96	1,09	1,20	1,30
Product to Concrete #2								
total volume flow	m³/h	0,23	0,45	0,53	0,60	0,66	0,72	0,77
test stand leakage	m³/h	0,06	0,20	0,22	0,25	0,26	0,28	0,29
specific air volume flow	m³/h	0,17	0,25	0,31	0,36	0,40	0,44	0,48
leakage volume flow based on area	m³/(h m²)	0,12	0,17	0,21	0,24	0,27	0,30	0,32
Product to Concrete #3								
total volume flow	m³/h	0,06	0,21	0,25	0,27	0,30	0,32	0,33
test stand leakage	m³/h	0,06	0,20	0,23	0,25	0,27	0,28	0,30
specific air volume flow	m³/h	0,01	0,02	0,02	0,03	0,03	0,04	0,05
leakage volume flow based on area	m³/(h m²)	0,01	0,01	0,02	0,02	0,02	0,03	0,03

Average

Q50 (PHI - assessment) **0,19** m³/(h m²)

resulting in an airtightness class of **C** according to PHI Q50 ≤ 0,25

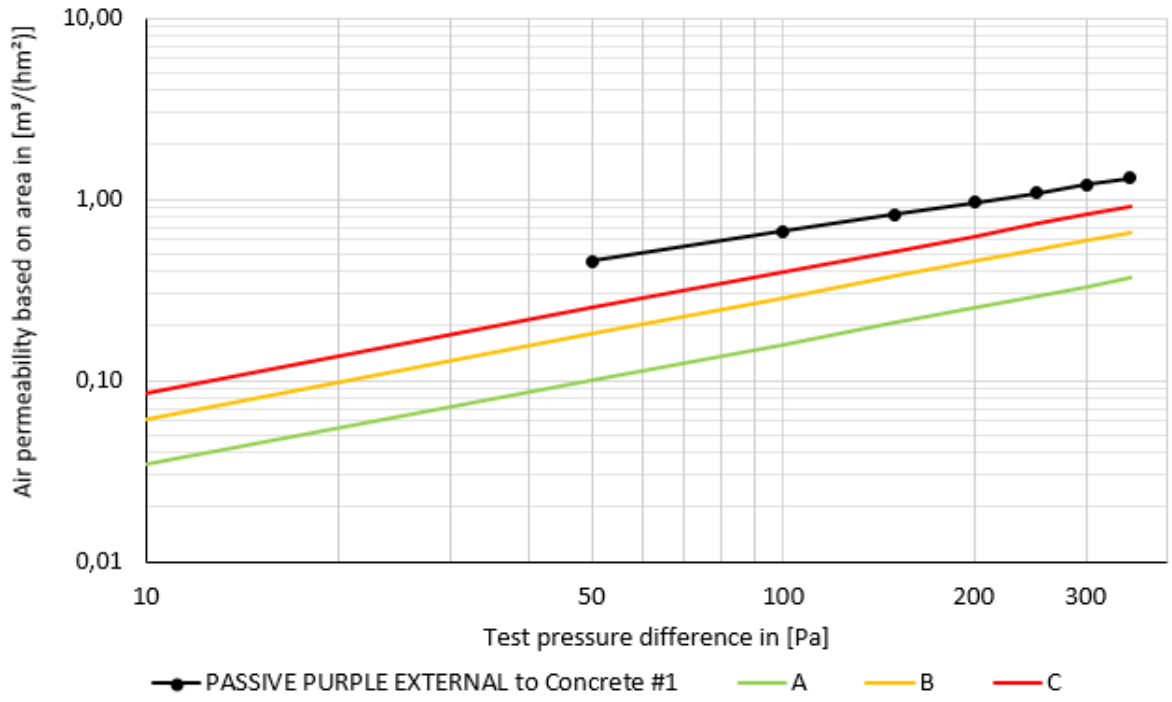

Fig 12: Series of measurements for the sample "PASSIVE PURPLE EXTERNAL to concrete #1". The Certification Classes A to C according to the PHI are entered in addition.

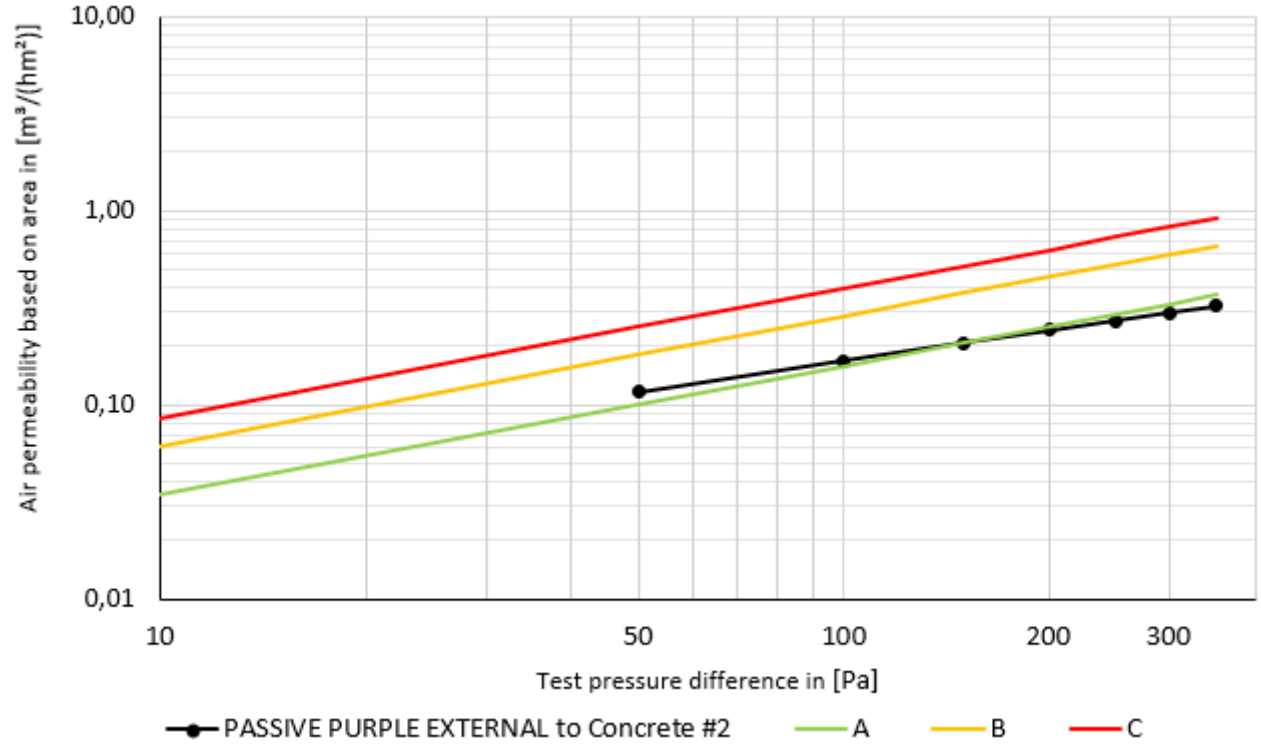

Fig 13: Series of measurements for the sample " PASSIVE PURPLE EXTERNAL to concrete #2" The Certification Classes A to C according to the PHI are entered in addition.

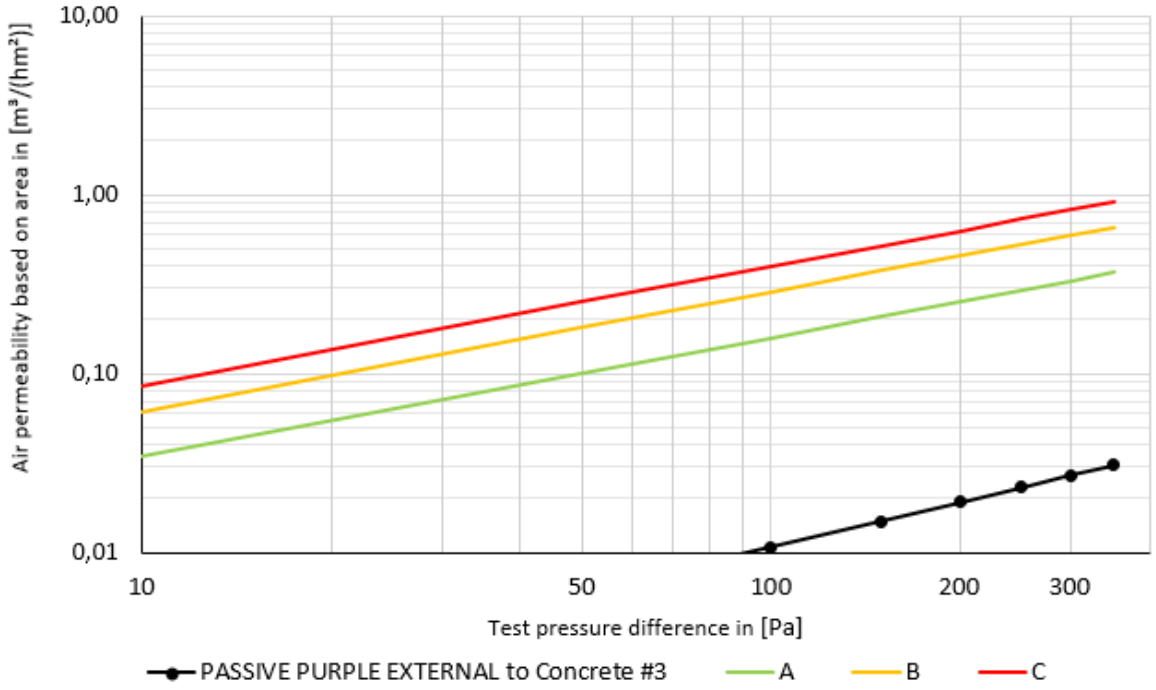

Fig 14: Series of measurements for the sample "PASSIVE PURPLE EXTERNAL to concrete #3". The Certification Classes A to C according to the PHI are entered in addition.

6.4 Observations

Small holes are noticed on some of the samples, as shown in Fig. 17, after spraying the product according to the instructions.

Fig 17: Air leakage is visualised with the help of an anemometer.

7. Test conditions

The average indoor climate conditions during the measurements and storage were as follows:

Indoor temperature: 20.4 °C
Indoor air humidity: 53.2 % r.H.

8. Measurement devices

A laminar flow element by the company TetraTec® Instruments was used for measuring the volume flow. The differential pressure was measured using an automated performance testing system (APT) by the manufacturer, The Energy Conservatory.

Table 5: Overview of the used measurement devices

Name	Device type	Serial number	Measurement range	Measurement accuracy
LaminarMasterFlow-System	LMF	PH796	0-85 l/min	2% in the range of 8-80 l/min
TEC Automated Performance Testing	APT	0072 4	0-2000 Pa	1 %

Results

The results of all measurements were compiled, and the overall average value was determined according to the type of connection. In doing so, the measured value for the product on its own (without any joining) was not taken into account because this concerns certification as a system and not material testing only.

On average, this resulted in an air permeability value of **0.016 (±0.013) m³/(hm²)** standardized for a test pressure of 50 Pa. The certification class "B" was achieved.

Table 6: Overview of the results of the airtightness measurement.

Average value of	m³/(hm²) @ 50 Pa
Membrane to membrane	0.18
Membrane to OSB	0.12
Membrane to concrete	0.19
Overall	**0.16 (±0.013)**

Table 7: Requirement class achieved by the examined product for certification as an "Airtightness system surface sealing" according to the specifications of the Passive House Institute.

Class	Air permeability based on length @ 50 Pa [m³/(hm²)]	Class achieved
ph**A**	≤ 0.10	
ph**B**	**≤ 0.18**	✓
ph**C**	≤ 0.25	

Darmstadt, 04.10.2024

Wolfgang Hasper