

# **Test Report**

## **Airtightness test of the sprayed airtightness layer including connections System "Passive Purple"**

**Manufacturer:  
Intelligent Membranes**

Airtightness system: Surface sealing

Darmstadt 10.12.2019

Passive House Institute  
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**Commissioned by:** **Intelligent Membranes**  
Clopton Farm, Lower Road  
Croydon, Cambridgeshire, SG8 0EF  
United Kingdom

**Product:** **Airtightness system consisting of**  
1. Passive Purple  
2. Primer 46  
3. Butytape

**Product name:** Passive Purple  
**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 took place under the most realistic possible boundary conditions within the framework of certification as a Passive House component 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 will be examined in the context of certification. With respect to the product system, this test examined the connection with membranes, concrete and hard engineered wood panels (here: OSB), as well as the adhesive materials used.

## 2. Criteria

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

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

<b>Class</b>	<b>Air permeability based on area @ 50 Pa [m<sup>3</sup>/(hm<sup>2</sup>)]</b>
phA	≤ 0.10
phB	≤ 0.18
phC	≤ 0.25

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

The required system components were supplied by the client.

For the regular surface the spray-applied sealing product Passive Purple is applied. Its primary use is on massive substrates. Connections to adjacent airtightness systems of a different type were made in the following ways:

- Connection with airtight membranes using adhesive tapes as specified by the membrane system manufacturer for use on concrete, sprayed over with Passive Purple
- Connection with adjacent concrete members using Butytape on the joint (surfaces prepared with Primer 46), sprayed over with Passive Purple
- Connection with adjacent engineered wooden board (OSB) members using Butytape on the joint (surfaces prepared with Primer 46), sprayed over with Passive Purple

The following products were delivered by the client on 09.05.2019:

- Passive Purple with datasheets
- Instructions for use
- Airless spray system GRACO classic 290 pc, spraytip 517

At a later stage were supplied

- Primer 46
- Butytape

## **4. Setup for the system and connections**

The sealing system was spray-applied in two coats with intermediate drying onto an air-permeable glass fibre substrate. For sealing, a frame which 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.

For the connection to OSB or concrete, an OSB panel or a concrete slab was joined with the butylic tapes specified by the client to the substrate and fused into the airtight layer by spraying over of the tapes.

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

### **4.1 Regular Surface**

The samples for the regular surface were made by spray-applying the system in two coats with intermediate drying onto an air-permeable substrate.

### **4.2 Membrane to membrane**

To test the connection of areas sealed with Passive Purple to areas sealed with airtightness membranes the exemplary certified membrane systems were joined with

the substrate using the respective tapes specified by the manufacturers for use on concrete and then sprayed over.

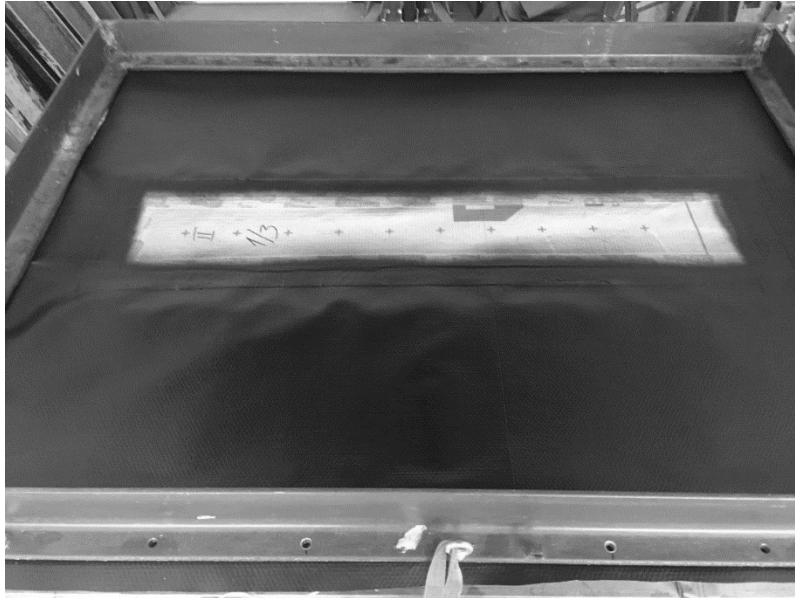


Fig. 1: Connection to a membrane-based air sealing system.

### 4.3 Membrane to concrete

The connection with concrete members was made with the adhesive sealing tape Butytape as specified by the client. To this end the 100 mm wide tape was applied centred on the joint between substrate and concrete inset. This yielded reliable results when prepared with Primer 46. The sample was completed by spraying over the substrate and tapes.

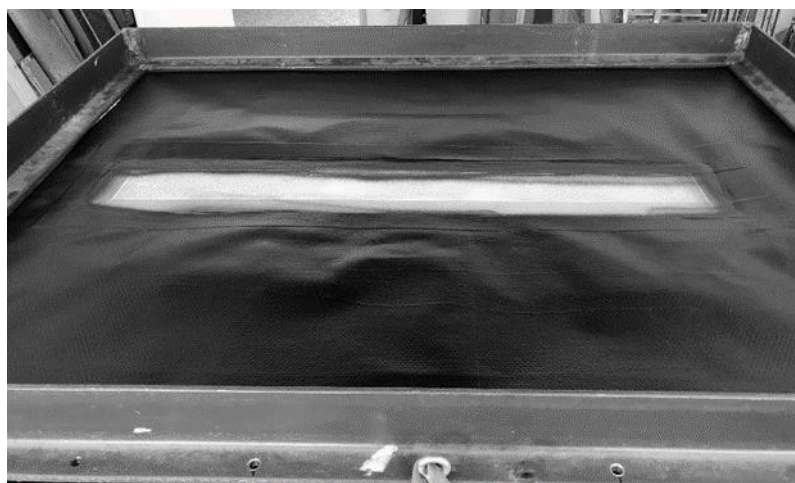


Fig. 2: Testing the joint with a concrete member

## 4.4 Membrane to OSB panel

The connection with OSB members was made with the adhesive sealing tape Butytape as specified by the client. To this end the 100 mm wide tape was applied centred on the joint between substrate and airtight OSB inset. This yielded reliable results when prepared with Primer 46. The sample was completed by spraying over the substrate and tapes.

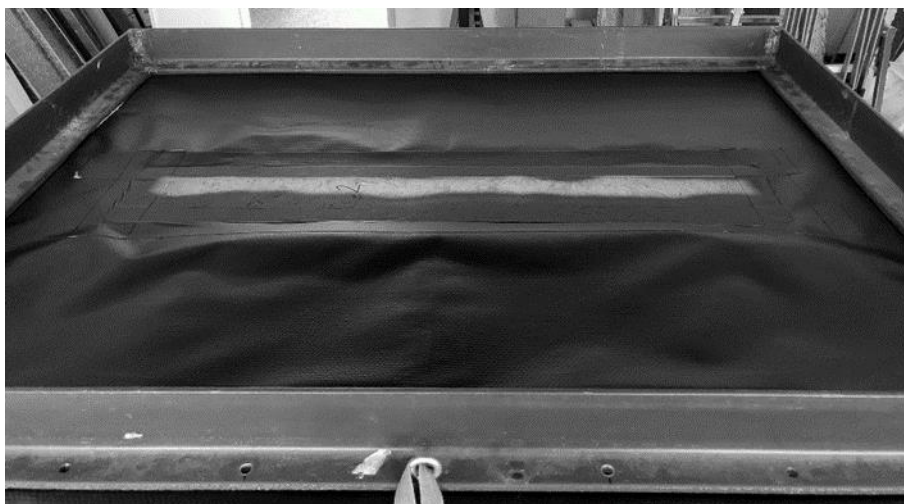


Fig. 3: Testing the joint with a wooden board member

## 5. Test procedure

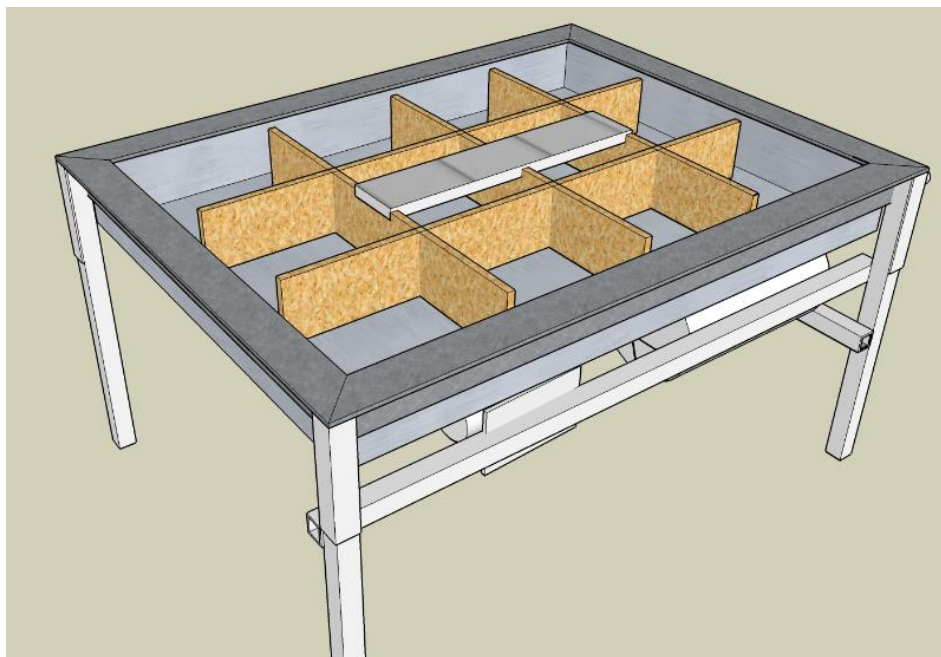
After setting up in the test stand and attaching the sample, a measurement was carried out in following DIN EN 12114. For this measurement, the following pressure stages were set for positive and negative pressure: 50, 100, 150, 200, 250, 300, 350 Pa. First the residual leakage of the test stand for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

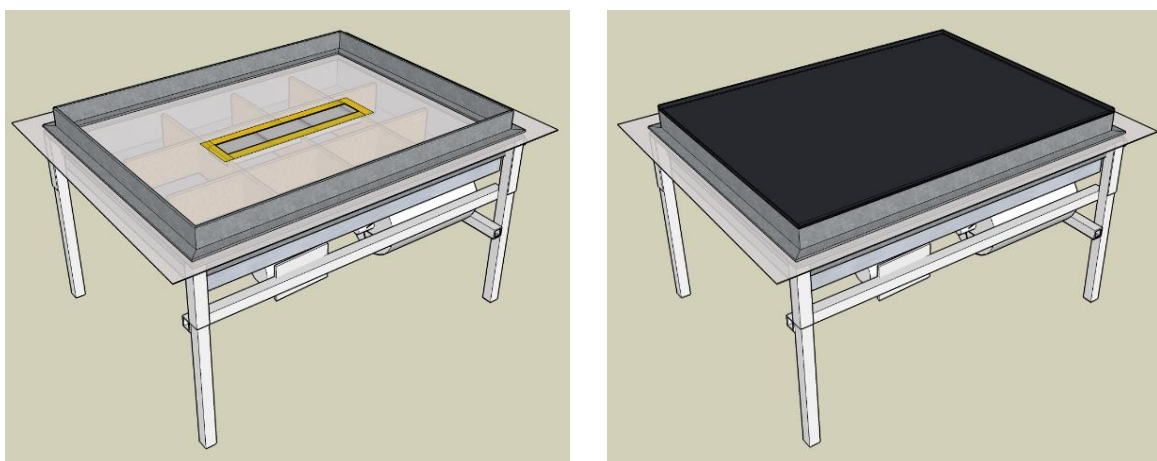
From the two series of reference measurements and the two series of actual measurements, smoothing functions were determined through a regression analysis. After deducting the leakage of the test stand itself (reference measurement), the leakage flow was determined for the reference pressure difference 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 free area of the sample is 1.72 m<sup>2</sup> or 1.48 m<sup>2</sup> with deduction of the cut-out for the OSB panel or concrete slab.



**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 11.06.2019 to 11.09.2019.

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## 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 recognisable because these are less than the smallest depicted y-axis value.



## 6.2 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 m <sup>2</sup>
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### Bonded using Butytape

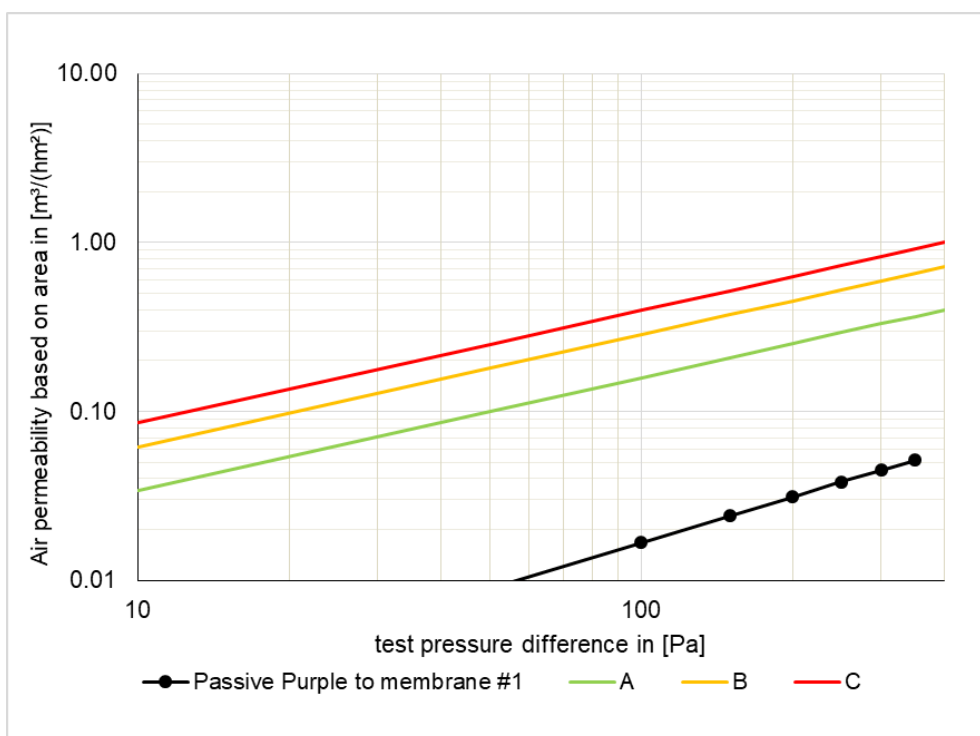
Pressure stages	Pa	50	100	150	200	250	300	350
Passive Purple to membrane #1								
total volume flow	m <sup>3</sup> /h	0.08	0.12	0.15	0.18	0.20	0.22	0.24
test stand leakage	m <sup>3</sup> /h	0.07	0.09	0.11	0.13	0.14	0.15	0.17
specific air volume flow	m <sup>3</sup> /h	0.01	0.02	0.04	0.05	0.06	0.07	0.08
leakage volume flow based on area	m <sup>3</sup> /(h m <sup>2</sup> )	0.01	0.02	0.02	0.03	0.04	0.04	0.05
Passive Purple to membrane #2								
total volume flow	m <sup>3</sup> /h	0.12	0.19	0.25	0.30	0.34	0.38	0.42
test stand leakage	m <sup>3</sup> /h	0.07	0.10	0.12	0.13	0.15	0.16	0.17
specific air volume flow	m <sup>3</sup> /h	0.05	0.10	0.15	0.19	0.24	0.28	0.32
leakage volume flow based on area	m <sup>3</sup> /(h m <sup>2</sup> )	0.04	0.07	0.10	0.13	0.16	0.19	0.22
Passive Purple to membrane #3								
total volume flow	m <sup>3</sup> /h	0.09	0.14	0.18	0.22	0.25	0.28	0.31
test stand leakage	m <sup>3</sup> /h	0.05	0.07	0.08	0.10	0.11	0.13	0.14
specific air volume flow	m <sup>3</sup> /h	0.04	0.07	0.09	0.12	0.14	0.15	0.17
leakage volume flow based on area	m <sup>3</sup> /(h m <sup>2</sup> )	0.03	0.05	0.06	0.08	0.09	0.10	0.12

Average

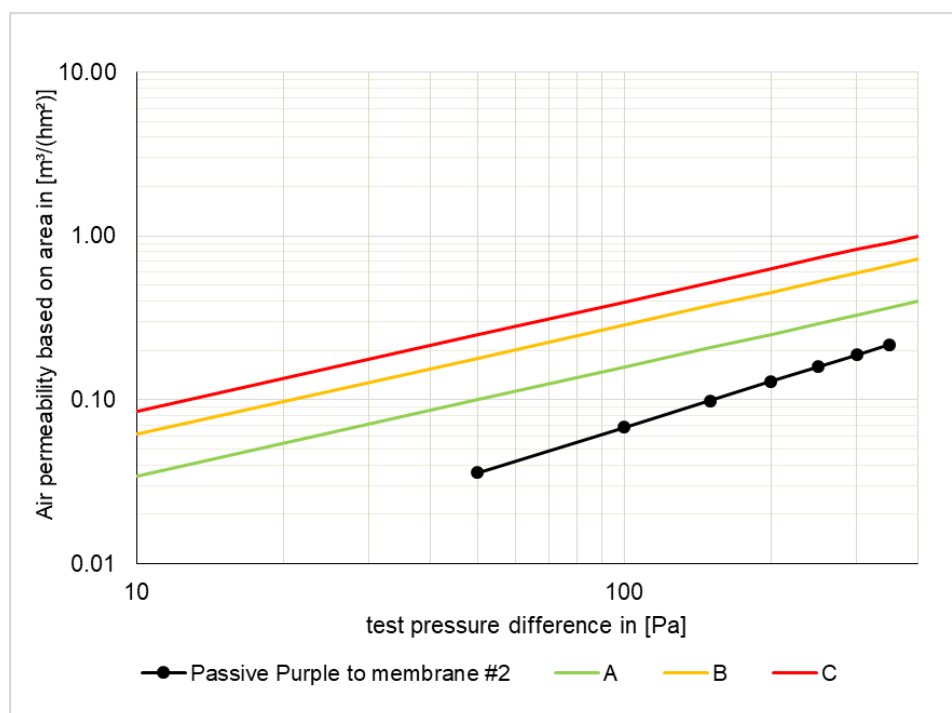
Q50 (PHI - assessment) **0.02** m<sup>3</sup>/(h m<sup>2</sup>)

resulting in an airtightness class of **A** according to PHI

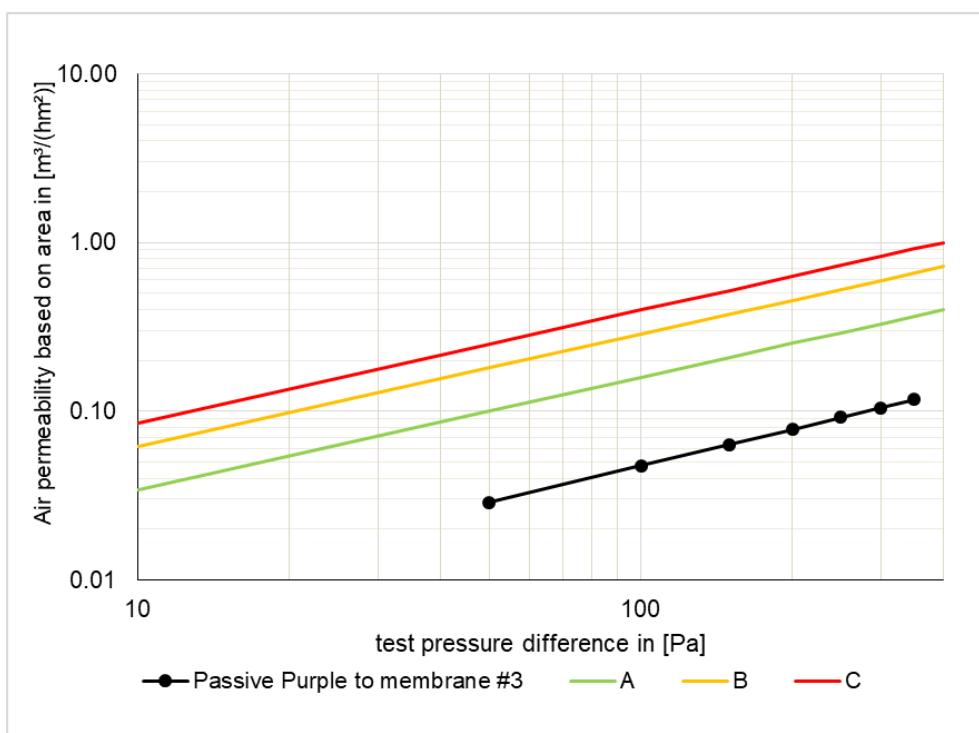
Q50 ≤ 0,1



**Fig. 6:** Series of measurements for the sample "Passive Purple/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/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/membrane #3" The Certification Classes A to C according to the PHI are entered in addition.

### 6.3 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 using Butytape**

examined area	1.48 m <sup>2</sup>
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#### Bonded using Butytape

Pressure stages	Pa	50	100	150	200	250	300	350
Passive Purple to OSB #1								
total volume flow	m <sup>3</sup> /h	0.10	0.15	0.19	0.22	0.25	0.28	0.31
test stand leakage	m <sup>3</sup> /h	0.06	0.09	0.11	0.12	0.14	0.15	0.17
specific air volume flow	m <sup>3</sup> /h	0.04	0.06	0.08	0.10	0.11	0.13	0.14
leakage volume flow based on area	m <sup>3</sup> /(h m <sup>2</sup> )	0.03	0.04	0.06	0.07	0.08	0.09	0.09
Passive Purple to OSB #3								
total volume flow	m <sup>3</sup> /h	0.11	0.18	0.24	0.30	0.36	0.41	0.46
test stand leakage	m <sup>3</sup> /h	0.05	0.08	0.10	0.12	0.13	0.15	0.16
specific air volume flow	m <sup>3</sup> /h	0.06	0.10	0.15	0.19	0.23	0.26	0.30
leakage volume flow based on area	m <sup>3</sup> /(h m <sup>2</sup> )	0.04	0.07	0.10	0.13	0.15	0.18	0.20
Passive Purple to OSB #3								
total volume flow	m <sup>3</sup> /h	0.09	0.13	0.17	0.21	0.24	0.27	0.30
test stand leakage	m <sup>3</sup> /h	0.05	0.08	0.10	0.12	0.14	0.15	0.17
specific air volume flow	m <sup>3</sup> /h	0.03	0.05	0.07	0.09	0.10	0.11	0.13
leakage volume flow based on area	m <sup>3</sup> /(h m <sup>2</sup> )	0.02	0.04	0.05	0.06	0.07	0.08	0.08

Average

Q50 (PHI - assessment) **0.03** m<sup>3</sup>/(h m<sup>2</sup>)

resulting in an airtightness class of **A** according to PHI

Q50 ≤ 0,1

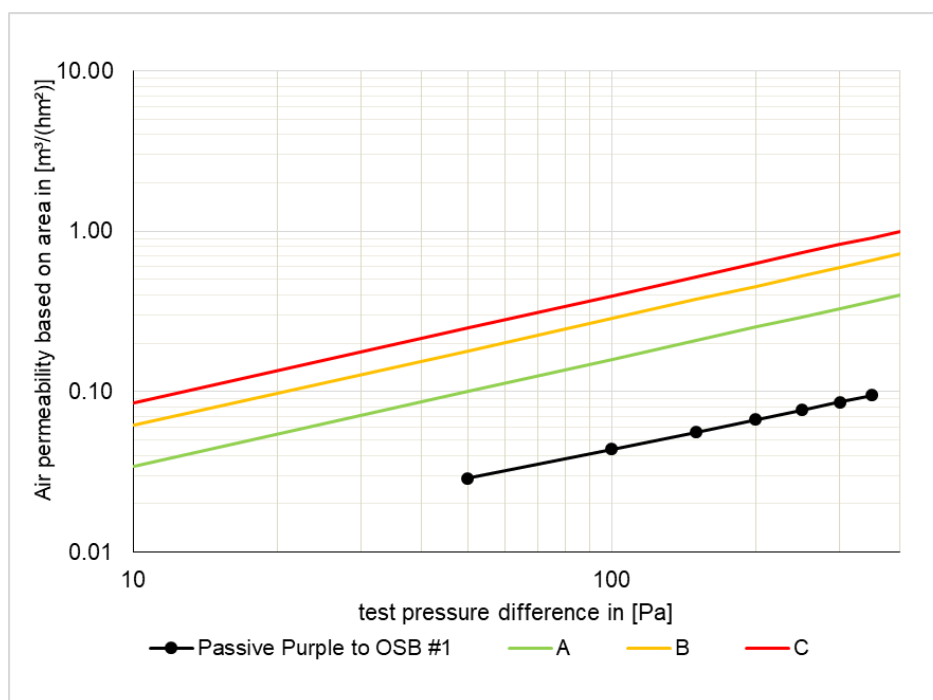


Fig. 9: Series of measurements for the sample "Passive Purple/OSB #1". The Certification Classes A to C according to the PHI are entered in addition.

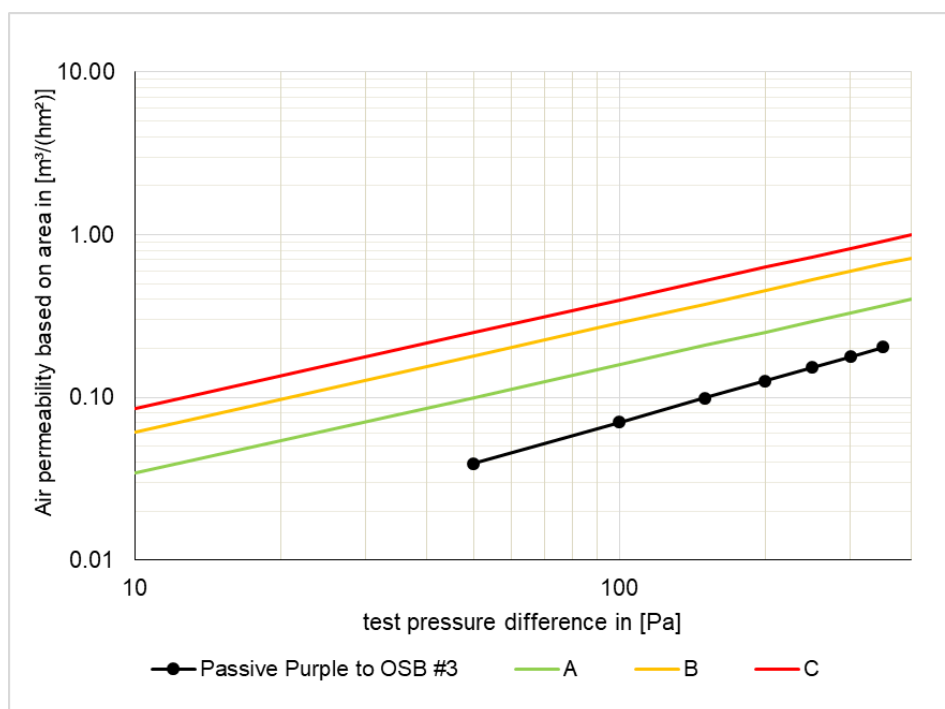


Fig. 10: Series of measurements for the sample "Passive Purple/OSB #2".. The Certification Classes A to C according to the PHI are entered in addition.

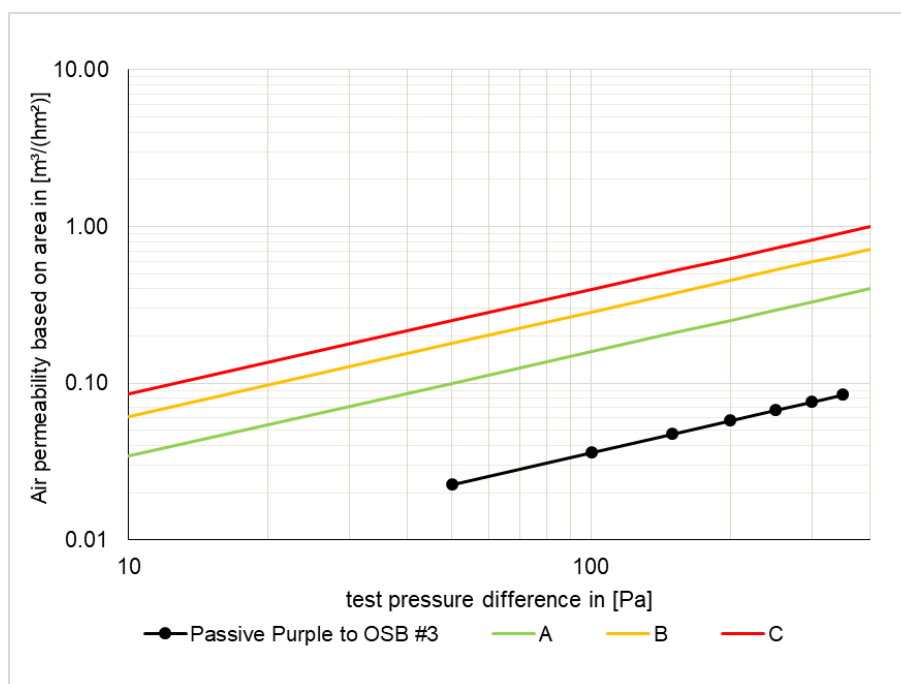


Fig. 11: Series of measurements for the sample "Passive Purple/OSB #3".. The Certification Classes A to C according to the PHI are entered in addition.

## 6.4 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 using Butytape**

examined area	1.48 m <sup>2</sup>
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### Bonded using Butytape

Pressure stages	Pa	50	100	150	200	250	300	350
Passive Purple to concrete #1								
total volume flow	m <sup>3</sup> /h	0.06	0.09	0.11	0.14	0.16	0.18	0.20
test stand leakage	m <sup>3</sup> /h	0.05	0.08	0.11	0.13	0.15	0.16	0.18
specific air volume flow	m <sup>3</sup> /h	0.00	0.00	0.00	0.00	0.01	0.01	0.01
leakage volume flow based on area	m <sup>3</sup> /(h m <sup>2</sup> )	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Passive Purple to concrete #2								
total volume flow	m <sup>3</sup> /h	0.07	0.11	0.15	0.18	0.20	0.23	0.26
test stand leakage	m <sup>3</sup> /h	0.05	0.08	0.10	0.12	0.14	0.15	0.17
specific air volume flow	m <sup>3</sup> /h	0.02	0.03	0.04	0.05	0.07	0.08	0.09
leakage volume flow based on area	m <sup>3</sup> /(h m <sup>2</sup> )	0.01	0.02	0.03	0.04	0.04	0.05	0.06
Passive Purple to concrete #3								
total volume flow	m <sup>3</sup> /h	0.06	0.09	0.12	0.15	0.17	0.19	0.21
test stand leakage	m <sup>3</sup> /h	0.05	0.08	0.10	0.12	0.14	0.16	0.17
specific air volume flow	m <sup>3</sup> /h	0.01	0.01	0.02	0.02	0.03	0.03	0.03
leakage volume flow based on area	m <sup>3</sup> /(h m <sup>2</sup> )	0.00	0.01	0.01	0.01	0.02	0.02	0.02

Average

Q50 (PHI - assessment) **0.01** m<sup>3</sup>/(h m<sup>2</sup>)

resulting in an airtightness class of **A** according to PHI

Q50 ≤ 0,1



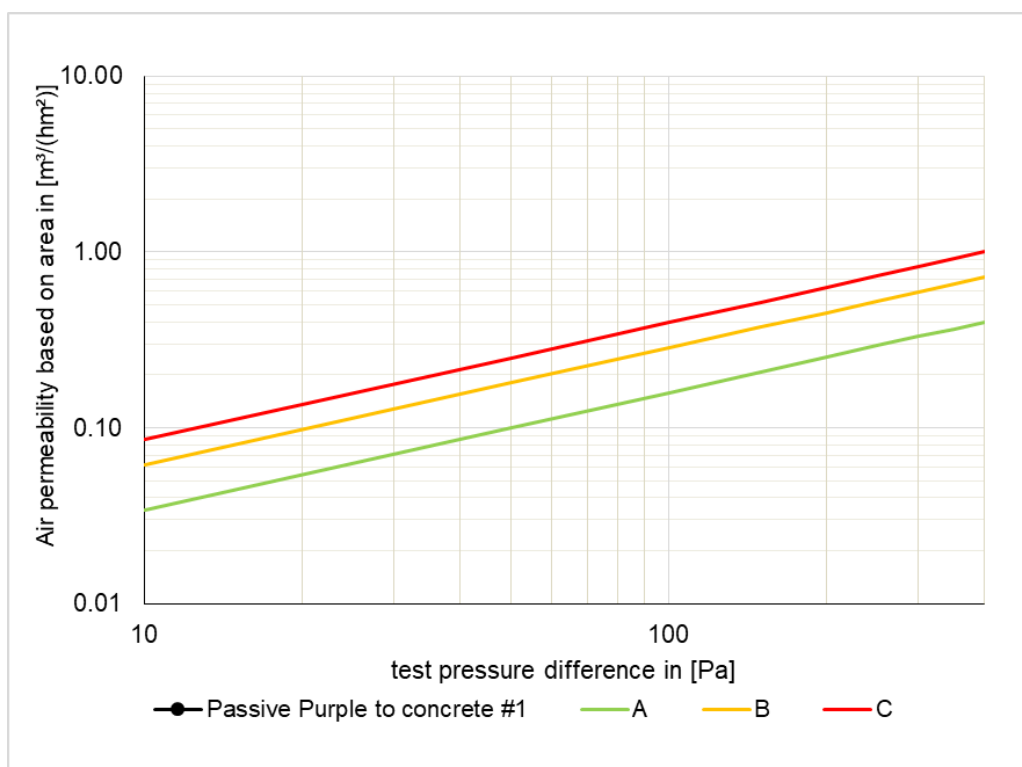


Fig. 12: Series of measurements for the sample "Passive Purple/concrete #1".. The Certification Classes A to C according to the PHI are entered in addition.

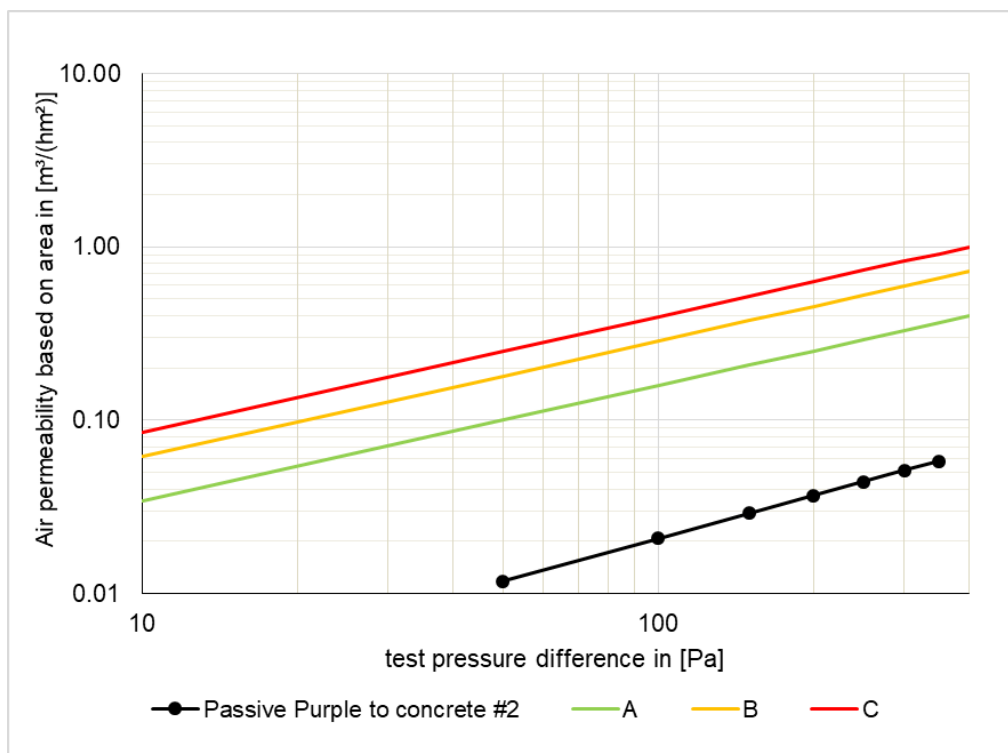


Fig. 13: Series of measurements for the sample "Passive Purple/concrete #2"... The Certification Classes A to C according to the PHI are entered in addition.

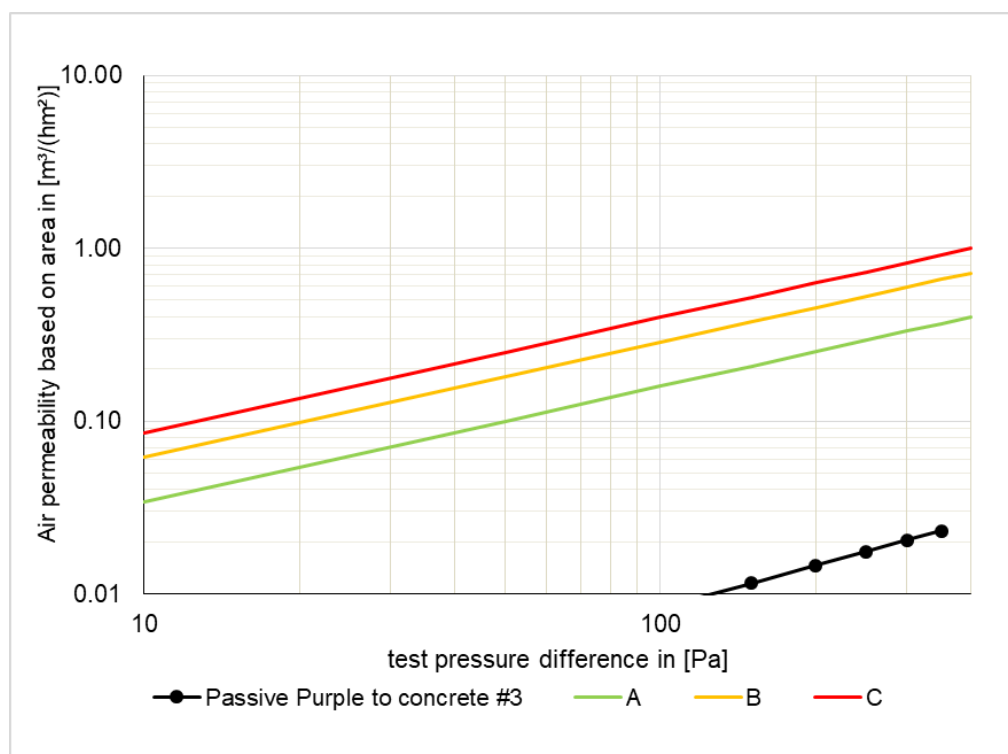


Fig. 14: Series of measurements for the sample "Passive Purple/concrete #3". The Certification Classes A to C according to the PHI are entered in addition.

## 7. Test conditions

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

Indoor temperature: 23.9 °C  
Indoor air humidity: 49.4 % 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 %

## 9. Results

The results of these measurements were compiled and the overall average value was created according to the type of connection. In doing so, the measured value for the membrane 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 **0.02 ( $\pm 0.002$ ) m<sup>3</sup>/(hm<sup>2</sup>)** standardised for a test pressure of 50 Pa. The certification class "A" was achieved.

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

Average value of	m <sup>3</sup> /(hm <sup>2</sup> ) @ 50 Pa
Membrane to membrane	0,02
Membrane to OSB	0,03
Membrane to concrete	0,01
<b>Overall</b>	<b>0,02 (<math>\pm 0,002</math>)</b>

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 [m <sup>3</sup> /(hm <sup>2</sup> )]	Class achieved
<b>phA</b>	<b>≤ 0.10</b>	<b>✓</b>
phB	≤ 0.18	
phC	≤ 0.25	

Darmstadt, 10.12.2019



Wolfgang Hasper