Test Report

Airtightness test of the engineered wood panel, including connections
System: "Finsa superPan Tech P5"

Manufacturer: Finsa

Airtightness system: Surface sealing

Darmstadt 14.08.2017

Passive House Institute
Dr. Wolfgang Feist
Rheinstr. 44/46
64291 Darmstadt, Germany
www.passiv.de

Commissioned by: FINSA
N-550, km. 57
15707 – Santiago de Compostela
A Coruña (Spain)

Product: **Airtightness system consisting of**

1. Finsa superPan Tech P5 engineered wood panel
2. SIGA Sicrall 60 single-sided adhesive tape
3. SIGA Fentrim 20 50/85 airtight high-performance tape with plastering zone

Product name: Finsa superPan Tech P5 (12 mm, 15 mm, 18 mm)

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 engineered timber panels to typical adjacent materials will be examined in the context of certification. With respect to the product system, this test examined the bonding of the engineered wood panels with each other and bonding with concrete and airtight membranes, 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: Requirements classes for the certification of surface sealing products according to Passive House Institute specifications

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

These apply for the overall performance of a product system specified by the client, which consists 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 testers.

The test pertains exclusively to the testing of air permeability of the system, other characteristics will not be a part of the test.

3. Materials to be tested

The required panels and adhesive tapes for joining the different connection situations were supplied by the client. The panels were provided in three different material thicknesses. Each panel thickness was tested separately for the three connection situations. The respective panel thicknesses were individually evaluated and certified.

In accordance with the manufacturer's instructions, the adhesive tape Sicrall® was used for the connection of two panels with each other. This adhesive tape was also used for the connection with the airtight membrane (SIGA Majrex). Connection to concrete took place using the adhesive tape Fentrim®. The use and application of adhesive tapes took place in accordance with the manufacturer's directions which are described in the instructions for use.

The following products were delivered by the client on 20.04.2017 and 28.04.2017:

- Finsa superPan Tech P5 with the following dimensions
  - 1.25 m x 2.50 m x 12 mm (width x length x height)
  - 1.25 m x 2.50 m x 15 mm (width x length x height)
  - 1.25 m x 2.50 m x 18 mm (width x length x height)
- SIGA Sicrall 60
- SIGA Fentrim 20 50/85

The manufacturer provided the "superPan TECH P5, AIRTIGHT PARTICLE BOARD, Best practice airtightness guidance document" as instructions for use and this was examined.

4. Setup for the panel and connections

The panels were cut to a size of 1.66 m and clamped in the measurement apparatus across its full width (1.25 m). For sealing, a frame identical to the lower frame of the test equipment was placed over the apparatus. The frame and counter frame were equipped with a 5 cm wide sealing surface to support the panel. 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 ensured due to the even pressure of the counter frame.

For the connection to an airtight membrane or a concrete surface, an opening (1.2 m x 0.2 m) was cut into the respective panel before clamping. In the case of connection to an airtight membrane, the airtight membrane was cut to size so that it rested on the panel with 2 cm all around, covering the opening. For the connection to concrete, a concrete slab was placed in the fixture provided for this purpose so that the concrete slab was flush with the panel. The panel thus surrounded the concrete slab after installation in the test stand. Depending on the type of connection, the panel was sealed either using Sicrall® (airtight membrane) or Fentrim® (concrete slab).

Each test setup (connection of the panel to another panel, an airtight membrane or a concrete slab) was created and measured three times in order to minimise any influences due to workmanship.

5. Panel to panel

The panel to panel connection was carried out according to the manufacturer's instructions using the adhesive tape Sicrall®. For this, the panels were placed flush next to each other and the adhesive tape was applied to both equally. The tape was then applied.

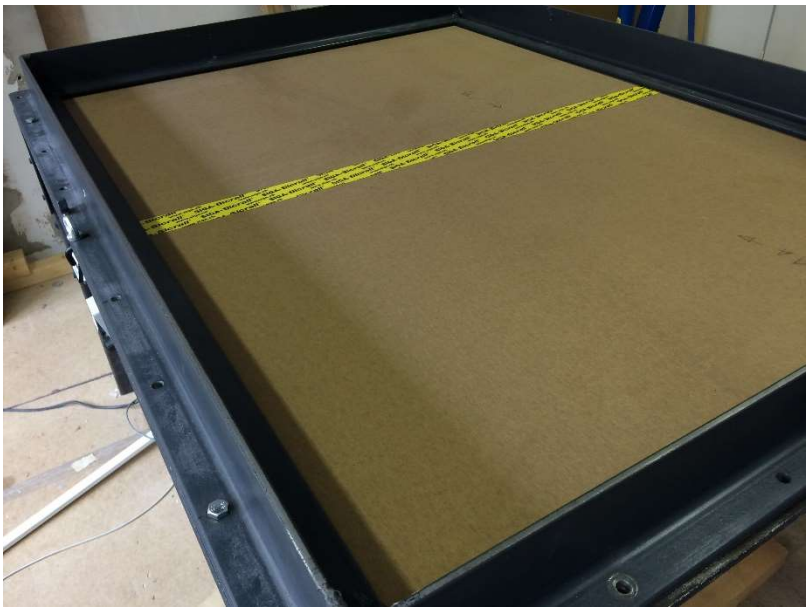

Fig. 1: Panel to panel connection created using Sicrall®. The panels are clamped into the test equipment (black frame).

6. Panel to concrete

The adhesive tape Fentrim® was used for the connection of the panel to concrete. This tape has a divided backing strip. First the narrow side was applied to the panel and then the other side of the tape was applied to the concrete slab. The perforated edge can be plastered over in addition. This was not done for this test. The adhesive tapes were first applied to both long sides. The subsequently applied tapes at the two short sides overlap with the first two tapes with their full width at the four corners.

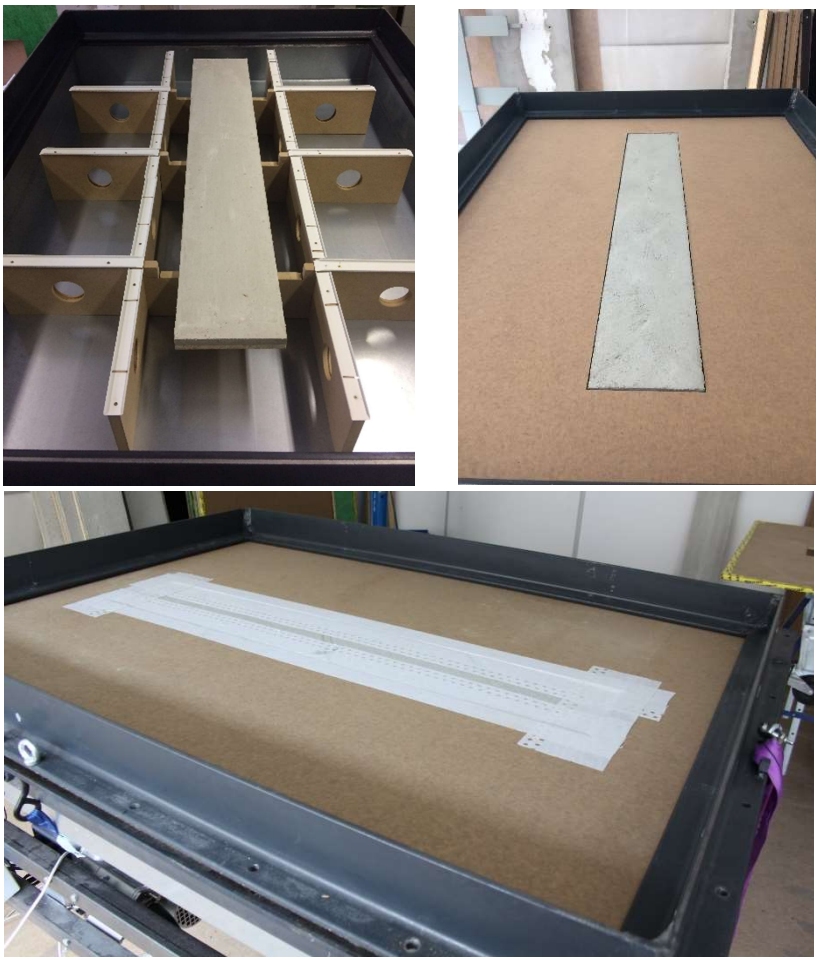

Fig. 2: **<u>Above left</u>: fixture for panels in the test apparatus with the concrete slab in position.**
<u>Above right</u>: concrete slab placed flush with the panel.
<u>Below</u>: panel clamped into the test stand, with tapes.

7. Panel to airtight membrane connection

The adhesive tape Sicrall® was used for connecting the panel to the airtight membrane. The airtight membrane (Majrex) was placed on the panel so that it extended beyond the corners. This was in accordance with the directions of the manufacturer and enables the tape to be applied adequately, as the panel serves as a substrate for adhesion. One half of the adhesive tape was applied to the panel and the other half was attached to the airtight membrane. The short sides were then taped, overlapping the long sections and extending over the four corners.

Fig. 3: **Left: engineered wood panel with the extending airtight membrane.**
Right: panel joined to the membrane on all four sides the using Sicrall® tape.

8. Test procedure

After placing the engineered wood panel in the test stand, a measurement was carried out in compliance with DIN EN 12114. The following pressure stages were set, each as a series of measurements at excess pressure and negative pressure:

50, 100, 150, 200, 250, 300 and 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 entire test apparatus was sealed from above with an airtight panel (cover). This measurement took place with the edges of the engineered wood panel sealed all around (using airtight adhesive tape). This was necessary so that any transverse air flow through the panel during the reference measurement was not registered as a leakage of the test stand itself (see Fig. 4).

The infiltration air of the test stand determined thus in the reference measurement was deducted from the measured result afterwards. Before the next test of the panel and

the connection, the adhesive tapes were removed from the edges all around so that any transverse air flow could also be registered. These transverse air flows may also occur when the panels are installed in a building.

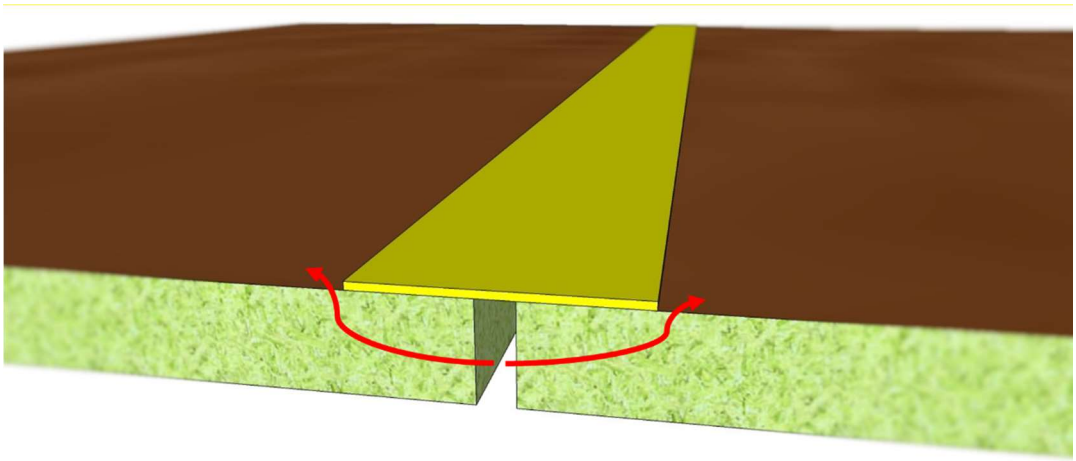

Fig. 4: **Sketch showing the connection point of the two wood panels. Adhesion was carried out using the adhesive tape (yellow). The red arrows show possible transverse air flows through the gap between the panels and through the panel itself. The gap in the panels is enlarged to illustrate this.**

In each measurement the transferred 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*** according to DIN 12114 Appendix B.

From the two series of reference measurements (at excess pressure and negative pressure) and the two series of actual measurements (at excess pressure and negative pressure), balancing functions were calculated by means of 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 (engineered wood panel) in order to obtain the specific leakage flow per square metre. The free area of the sample was 1.72 m². For the measurements with the cutout for the airtight membrane and the concrete slab, this area was reduced to 1.48 m².

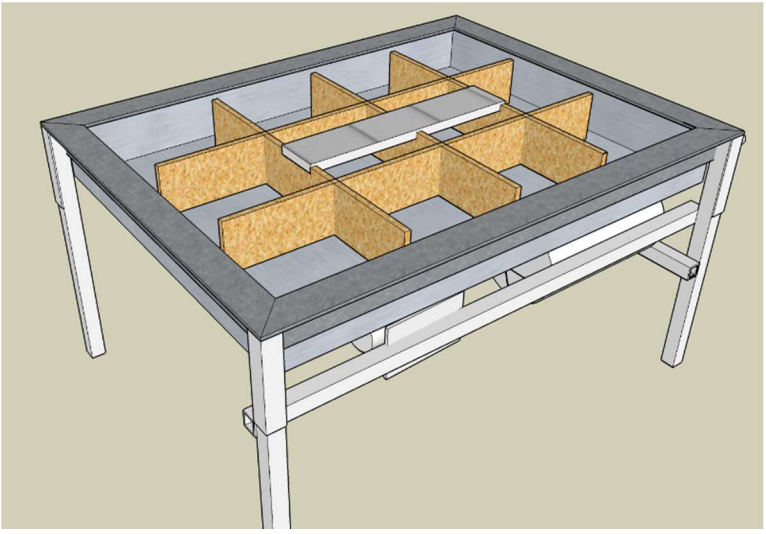

Fig. 5: **Sketch of the test apparatus with a fixture for a concrete slab**

Fig. 6: **<u>Left</u>: Sketch of the test apparatus with the mounted engineered wood panel, installed concrete slab and adhesive tape (white).**
<u>Right</u>: Test apparatus sealed with the cover panel for determining the test stand leakage (reference measurement).

The measurements of the examined airtightness system took place in the time period 29.04.2017 to 15.07.2017.

9. Test results

The test results are shown in the following tables and figures, sorted according to the connection methods and the panel thicknesses. These are preceded by the measurements of the engineered wood panels alone (without connections). The requirement classes for the certification of surface sealing systems have been entered additionally in the diagrams.

9.1 Panel on its own (without connections)

9.1.1 Engineered wood panel thickness = 12 mm

Connection to	
Panel on its own	x
Panel to panel	
Panel to membrane	
Panel to concrete	

Table 2: Results of the three measurements with the engineered wood panel (thickness= 12 mm) without connection

examined thickness	12,00 mm
examined area	1,72 m²

superPan Tech P5 #1 (d=12mm)

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,25	0,49	0,72	0,95	1,18	1,40	1,62
test stand leakage	m³/h	0,05	0,07	0,08	0,10	0,11	0,12	0,13
specific air volume flow	m³/h	0,21	0,42	0,63	0,85	1,07	1,28	1,50
leakage volume flow based on area	m³/(h m²)	0,12	0,24	0,37	0,50	0,62	0,75	0,88

superPan Tech P5 #2 (d=12mm)

total volume flow	m³/h	0,26	0,50	0,74	0,98	1,21	1,44	1,67
test stand leakage	m³/h	0,04	0,06	0,08	0,09	0,11	0,12	0,13
specific air volume flow	m³/h	0,22	0,44	0,66	0,88	1,11	1,33	1,56
leakage volume flow based on area	m³/(h m²)	0,13	0,25	0,38	0,51	0,64	0,78	0,91

superPan Tech P5 #3 (d=12mm)

total volume flow	m³/h	0,26	0,49	0,72	0,94	1,16	1,38	1,59
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,11	0,13	0,14
specific air volume flow	m³/h	0,21	0,42	0,63	0,85	1,06	1,27	1,48
leakage volume flow based on area	m³/(h m²)	0,12	0,25	0,37	0,49	0,62	0,74	0,86

Average

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

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

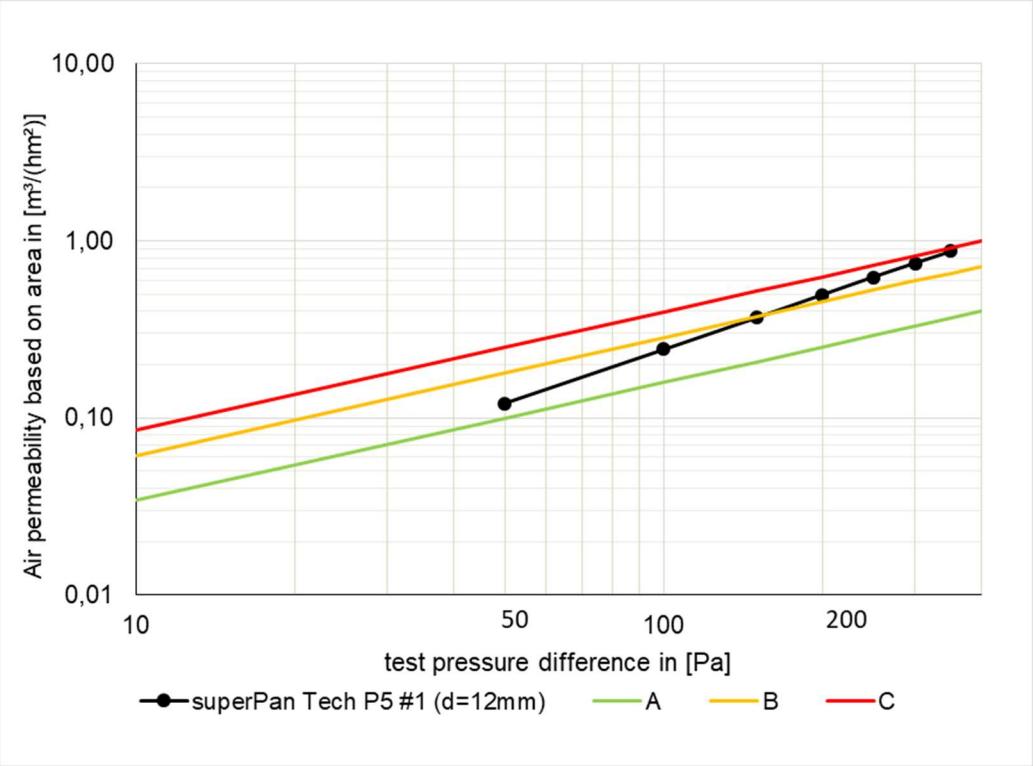

Fig. 7: **Series of measurements for the sample "Finsa superPan Tech P5 #1" (thickness= 12 mm) (engineered wood panel on its own). The certificate classes A to C according to the PHI are entered in addition.**

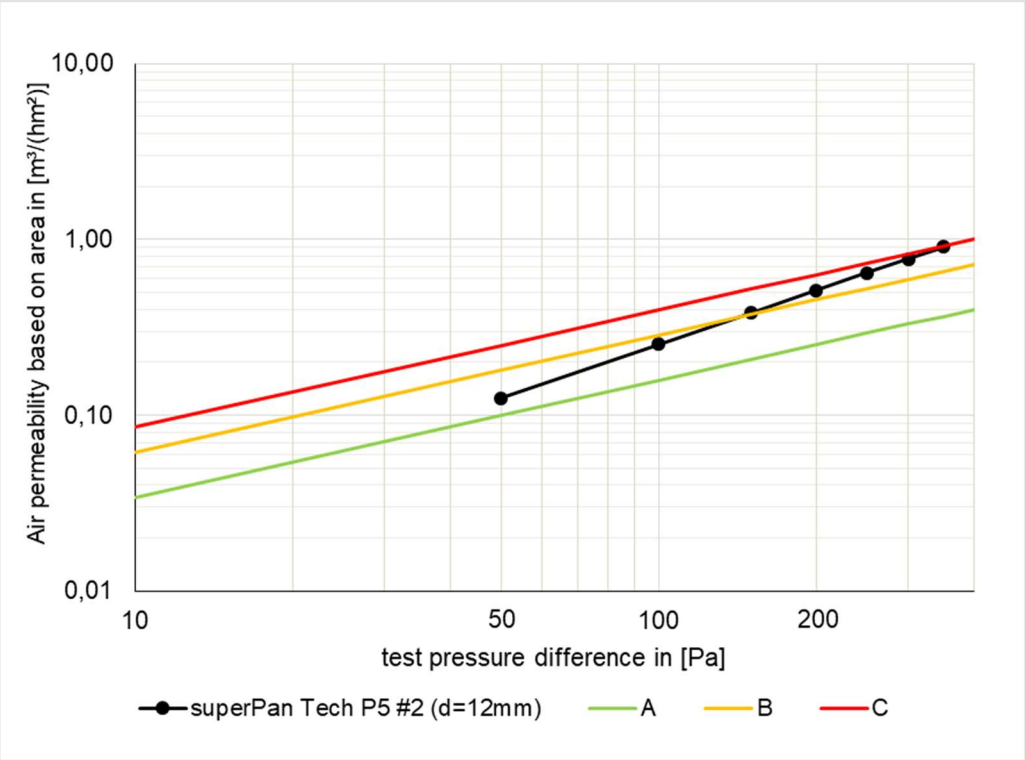

Fig. 8: **Series of measurements for the sample "Finsa superPan Tech P5 #2" (thickness= 12 mm) (engineered wood panel on its own). The certificate classes A to C according to the PHI are entered in addition.**

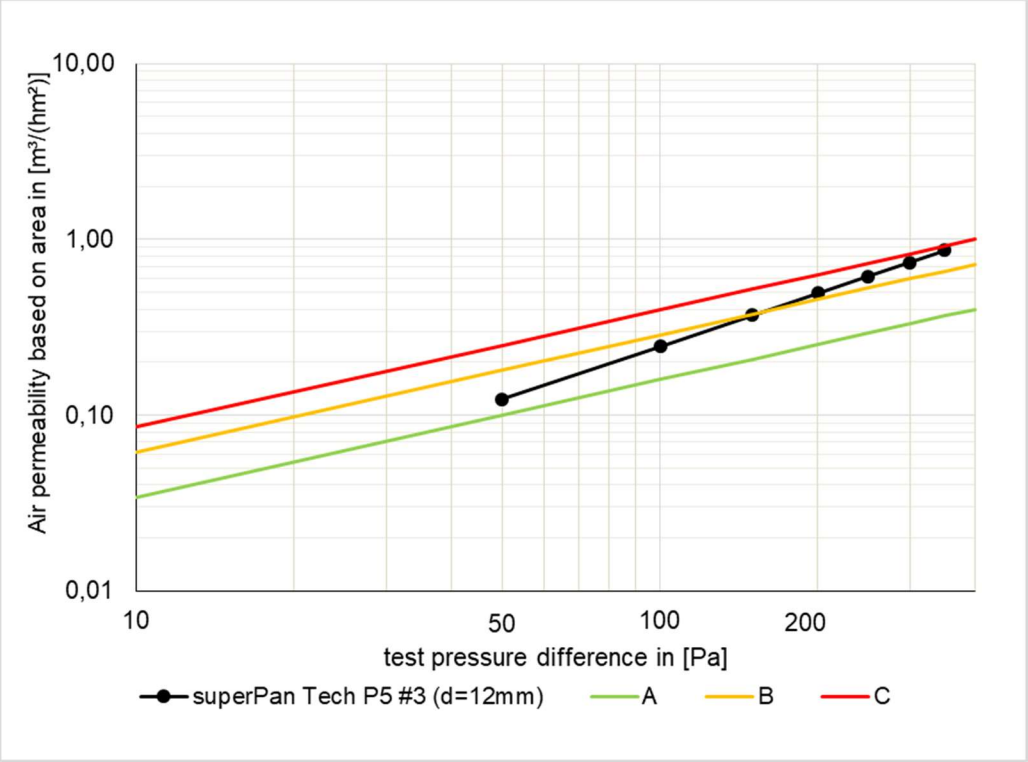

Fig. 9: **Series of measurements for the sample "Finsa superPan Tech P5 #3 (thickness= 12 mm)" (engineered wood panel on its own). The certificate classes A to C according to the PHI are entered in addition.**

9.1.2 Engineered wood panel thickness= 15 mm

Connection to	
Panel on its own	x
Panel to panel	
Panel to membrane	
Panel to concrete	

Table 3: Results of the three measurements with the engineered wood panel (thickness= 15 mm) without connection

examined thickness	15,00 mm
examined area	1,72 m²

superPan Tech P5 #1 (d=15mm)

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,20	0,38	0,56	0,73	0,90	1,06	1,23
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,12	0,13	0,14
specific air volume flow	m³/h	0,15	0,31	0,46	0,62	0,77	0,93	1,09
leakage volume flow based on area	m³/(h m²)	0,09	0,18	0,27	0,36	0,45	0,54	0,63

superPan Tech P5 #2 (d=15mm)

total volume flow	m³/h	0,19	0,36	0,53	0,69	0,84	1,00	1,15
test stand leakage	m³/h	0,05	0,07	0,09	0,11	0,12	0,14	0,15
specific air volume flow	m³/h	0,14	0,28	0,43	0,57	0,71	0,86	1,00
leakage volume flow based on area	m³/(h m²)	0,08	0,16	0,25	0,33	0,42	0,50	0,58

superPan Tech P5 #3 (d=15mm)

total volume flow	m³/h	0,20	0,38	0,55	0,71	0,88	1,04	1,20
test stand leakage	m³/h	0,05	0,07	0,09	0,11	0,13	0,14	0,15
specific air volume flow	m³/h	0,15	0,30	0,45	0,61	0,76	0,91	1,07
leakage volume flow based on area	m³/(h m²)	0,09	0,18	0,26	0,35	0,44	0,53	0,62

Average

Q50 (PHI - assessment) **0,09** m³/(h m²)

resulting in an airtightness class of **A** according to PHI Q50 ≤ 0,1

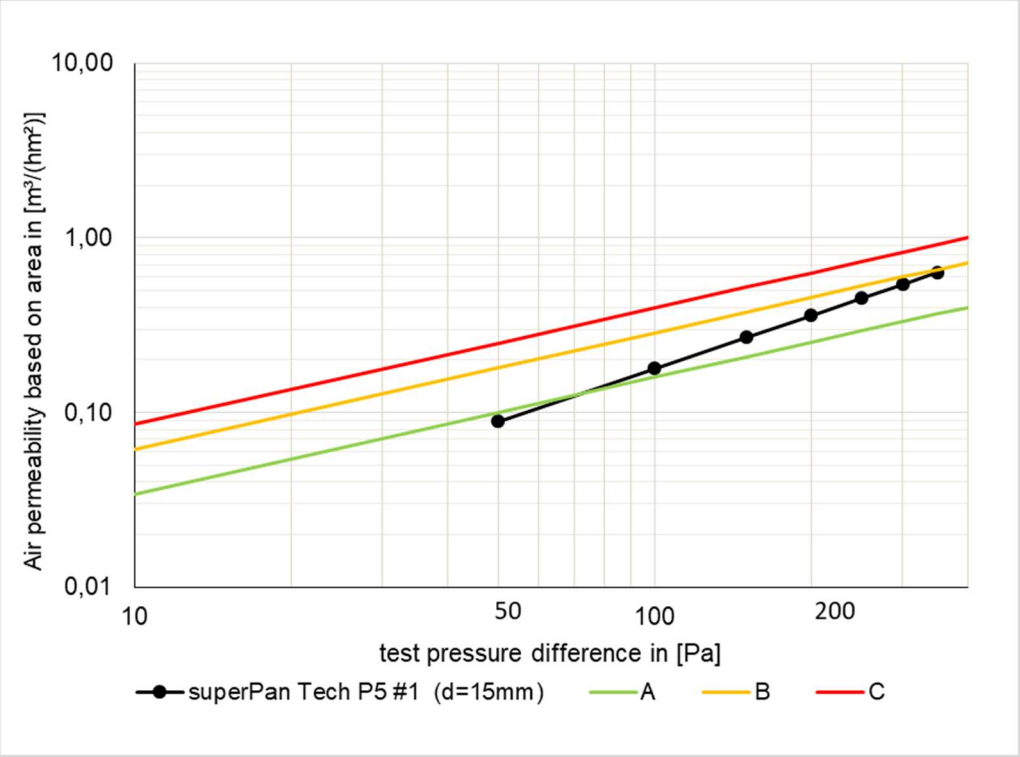

Fig. 10: **Series of measurements for the sample "Finsa superPan Tech P5 #1" (thickness= 15 mm) (engineered wood panel on its own). The certificate classes A to C according to the PHI are entered in addition.**

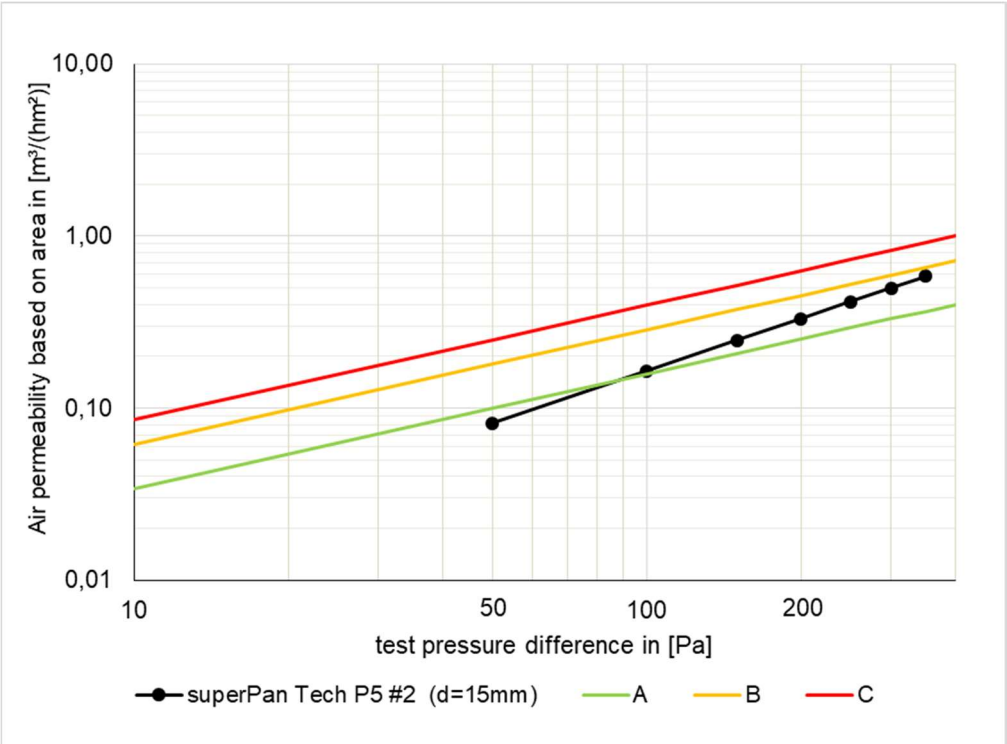

Fig. 11: **Series of measurements for the sample "Finsa superPan Tech P5 #2" (thickness= 15 mm) (engineered wood panel on its own). The certificate classes A to C according to the PHI are entered in addition.**

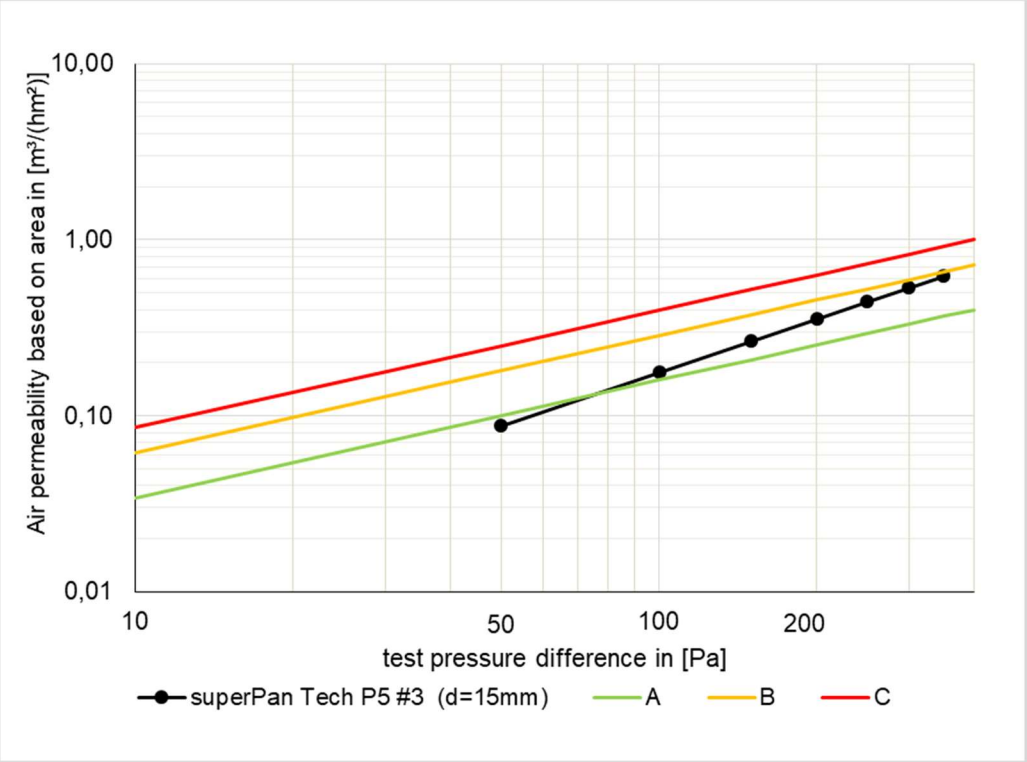

Fig. 12: **Series of measurements for the sample "Finsa superPan Tech P5 #3 (thickness= 15 mm)" (engineered wood panel on its own). The certificate classes A to C according to the PHI are entered in addition.**

9.1.3 Engineered wood panel thickness= 18 mm

Connection to	
Panel on its own	x
Panel to panel	
Panel to membrane	
Panel to concrete	

Table 4: Results of the three measurements with the engineered wood panel (thickness= 18 mm) without connection

examined thickness	18,00 mm
examined area	1,72 m²

superPan Tech P5 #1 (d=18mm)

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,13	0,25	0,36	0,47	0,58	0,68	0,79
test stand leakage	m³/h	0,04	0,06	0,08	0,09	0,11	0,12	0,13
specific air volume flow	m³/h	0,09	0,18	0,28	0,37	0,47	0,56	0,66
leakage volume flow based on area	m³/(h m²)	0,05	0,11	0,16	0,22	0,27	0,33	0,38

superPan Tech P5 #2 (d=18mm)

total volume flow	m³/h	0,15	0,28	0,40	0,52	0,64	0,76	0,87
test stand leakage	m³/h	0,05	0,08	0,10	0,11	0,13	0,14	0,16
specific air volume flow	m³/h	0,10	0,20	0,30	0,41	0,51	0,62	0,72
leakage volume flow based on area	m³/(h m²)	0,06	0,12	0,18	0,24	0,30	0,36	0,42

superPan Tech P5 #3 (d=18mm)

total volume flow	m³/h	0,14	0,27	0,38	0,50	0,61	0,71	0,82
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,11	0,12	0,13
specific air volume flow	m³/h	0,09	0,19	0,29	0,39	0,48	0,58	0,68
leakage volume flow based on area	m³/(h m²)	0,06	0,11	0,17	0,23	0,28	0,34	0,40

Average

Q50 (PHI - assessment) **0,06** m³/(h m²)

resulting in an airtightness class of **A** according to PHI Q50 ≤ 0,1

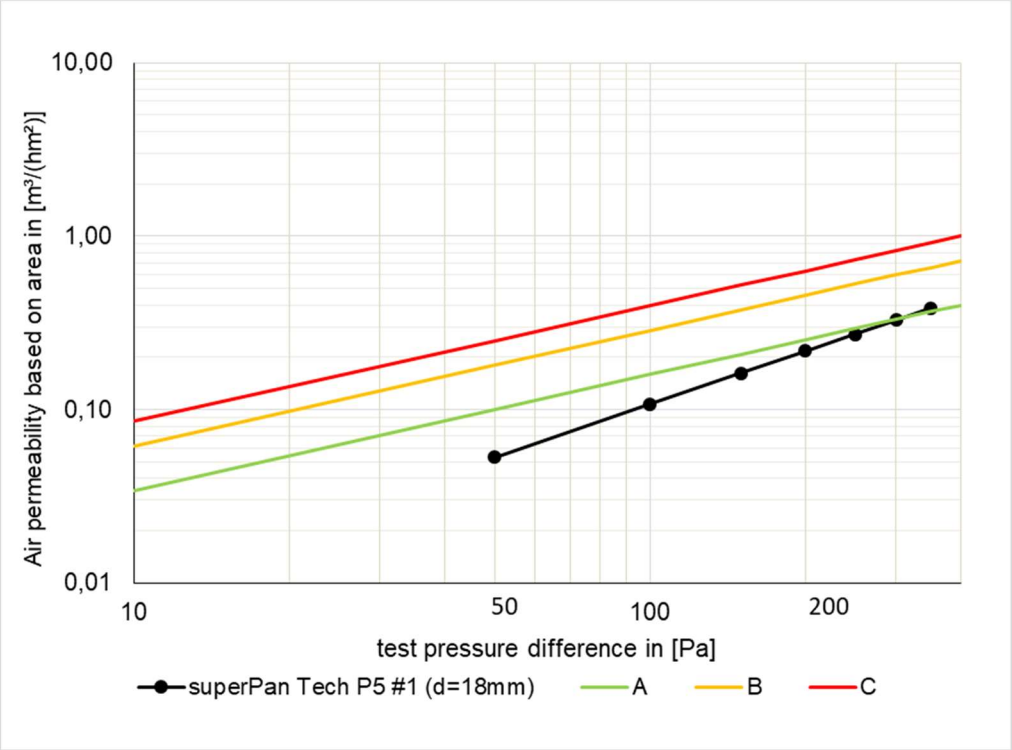

Fig. 13: **Series of measurements for the sample "Finsa superPan Tech P5 #1" (thickness= 18 mm) (engineered wood panel on its own). The certificate classes A to C according to the PHI are entered in addition.**

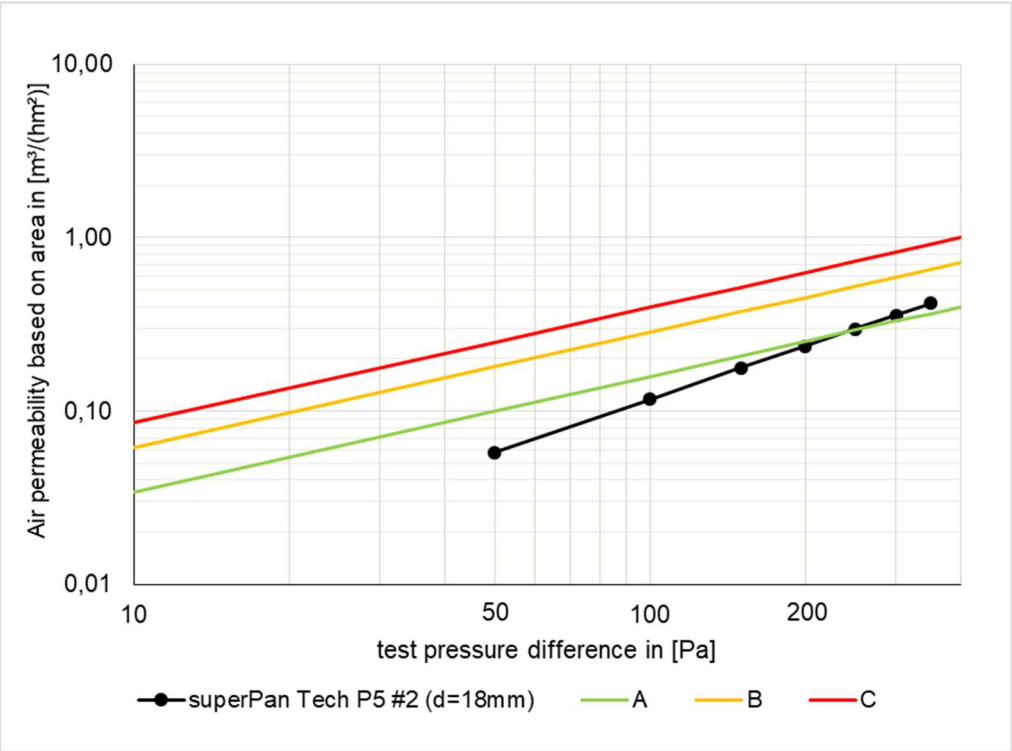

Fig. 14: **Series of measurements for the sample "Finsa superPan Tech P5 #2" (thickness= 18 mm) (engineered wood panel on its own). The certificate classes A to C according to the PHI are entered in addition.**

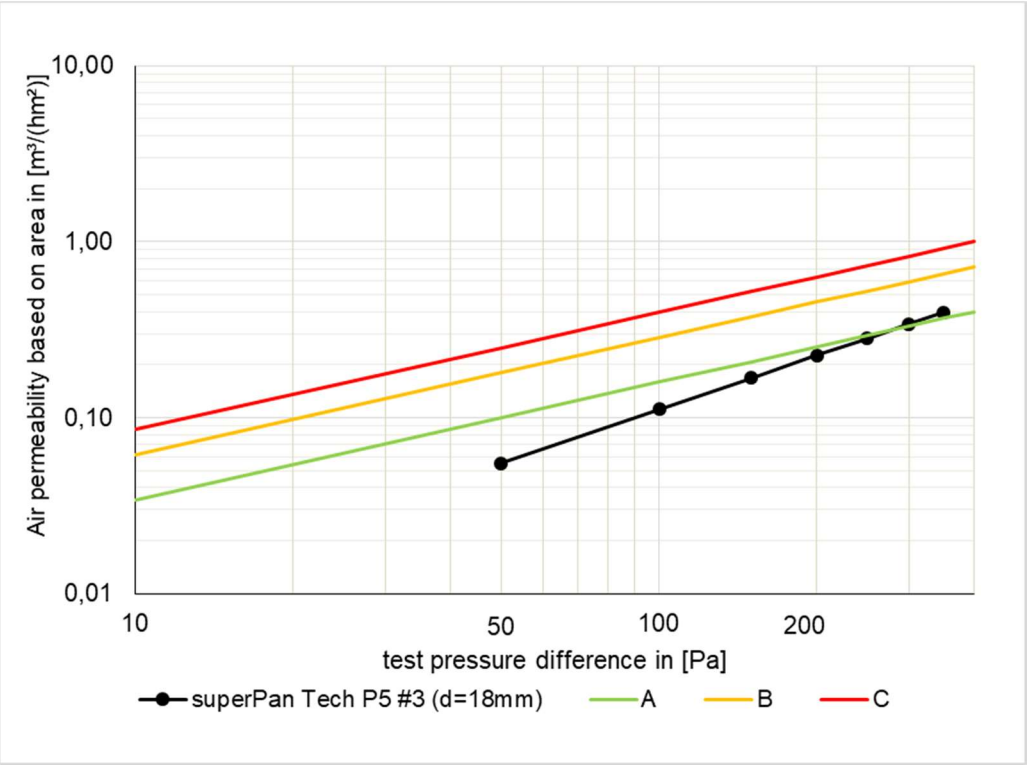

Fig. 15: **Series of measurements for the sample "Finsa superPan Tech P5 #3 (thickness= 18 mm)" (engineered wood panel on its own). The certificate classes A to C according to the PHI are entered in addition.**

9.2 Panel to panel connection

9.2.1 Engineered wood panel to engineered wood panel, thickness = 12 mm

Connection to	
Panel on its own	
Panel to panel	x
Panel to membrane	
Panel to concrete	

Table 5: Results of the three measurements with the panel to panel (thickness= 12 mm) connection using Sicrall®[1]

examined thickness	12,00 mm
examined area	1,72 m²

superPan Tech P5 to superPan Tech P5 #1 (d=12mm) bonded using Sicrall

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,29	0,55	0,81	1,06	1,31	1,55	1,79
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,11	0,12	0,13
specific air volume flow	m³/h	0,24	0,48	0,72	0,96	1,20	1,44	1,68
leakage volume flow based on area	m³/(h m²)	0,14	0,28	0,42	0,56	0,70	0,84	0,98

superPan Tech P5 to superPan Tech P5 #2 (d=12mm)

total volume flow	m³/h	0,26	0,51	0,75	0,98	1,22	1,45	1,68
test stand leakage	m³/h	0,04	0,06	0,08	0,09	0,11	0,12	0,13
specific air volume flow	m³/h	0,22	0,44	0,66	0,89	1,11	1,34	1,56
leakage volume flow based on area	m³/(h m²)	0,13	0,26	0,39	0,52	0,65	0,78	0,91

superPan Tech P5 to superPan Tech P5 #3 (d=12mm)

total volume flow	m³/h	0,26	0,50	0,74	0,97	1,20	1,42	1,65
test stand leakage	m³/h	0,04	0,07	0,08	0,10	0,11	0,12	0,13
specific air volume flow	m³/h	0,21	0,43	0,65	0,87	1,09	1,32	1,54
leakage volume flow based on area	m³/(h m²)	0,13	0,25	0,38	0,51	0,64	0,77	0,90

Average

Q50 (PHI - assessment) **0,13** m³/(h m²)

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

[1] The differences are due to rounding

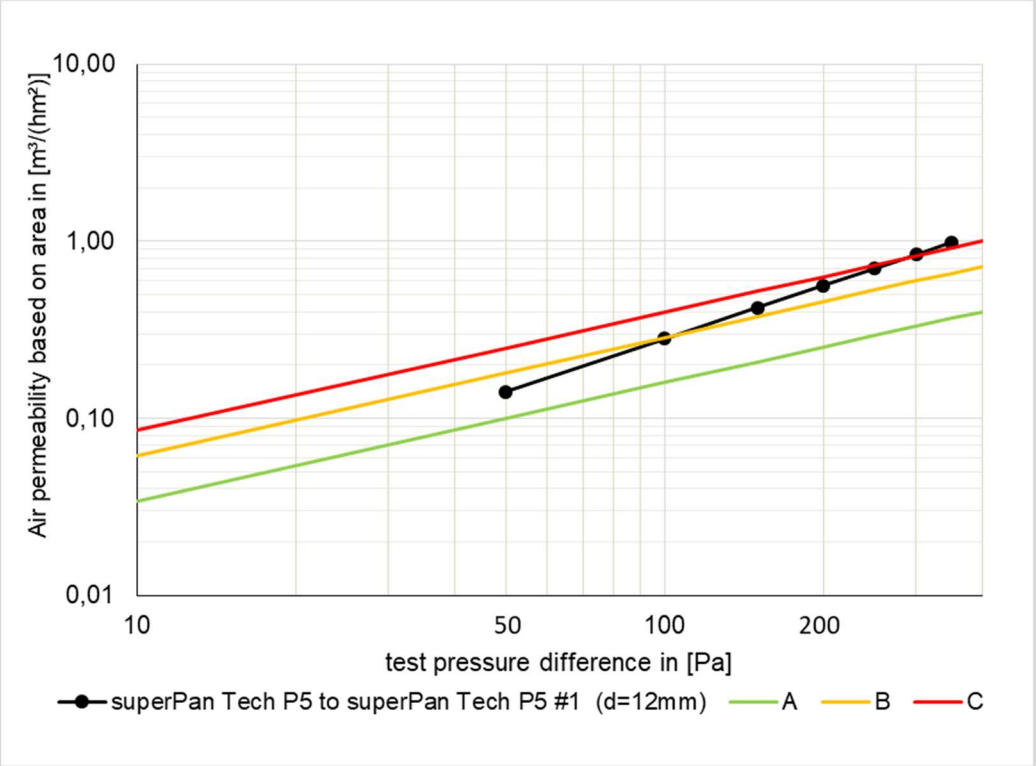

Fig. 16: **Series of measurements for the sample "Finsa superPan Tech P5 to Finsa superPan Tech P5 #1" (thickness= 12 mm). The certificate classes A to C according to the PHI are entered in addition.**

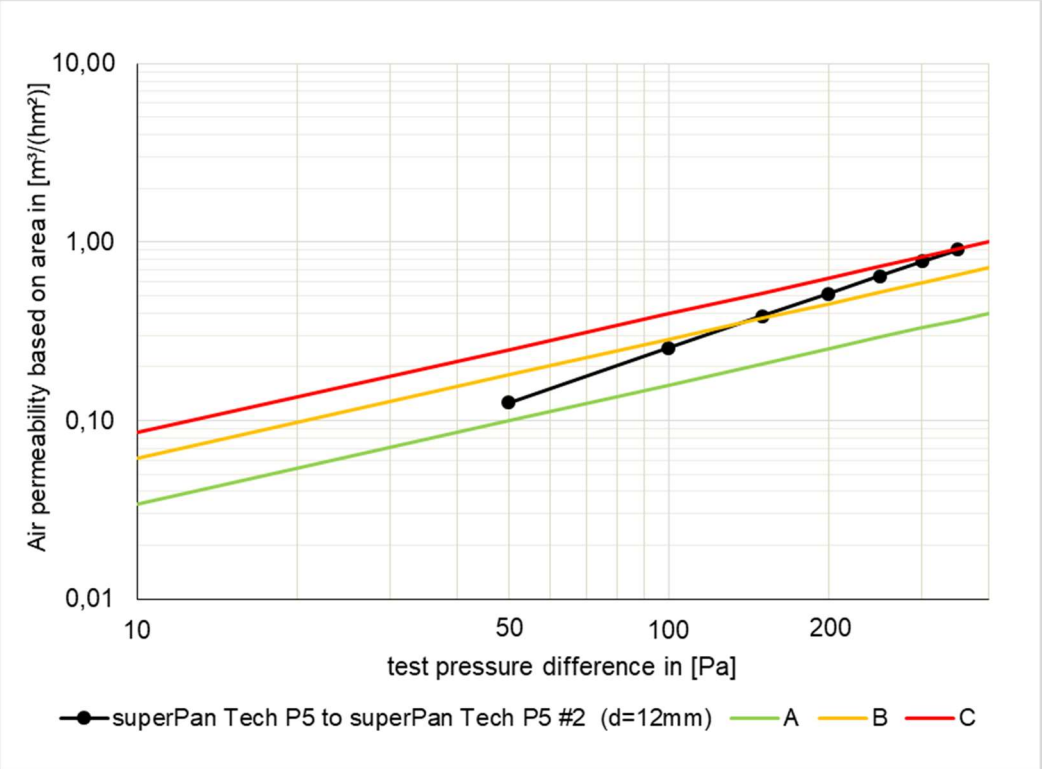

Fig. 17: **Series of measurements for the sample "Finsa superPan Tech P5 to Finsa superPan Tech P5 #2" (thickness= 12 mm). The certificate classes A to C according to the PHI are entered in addition.**

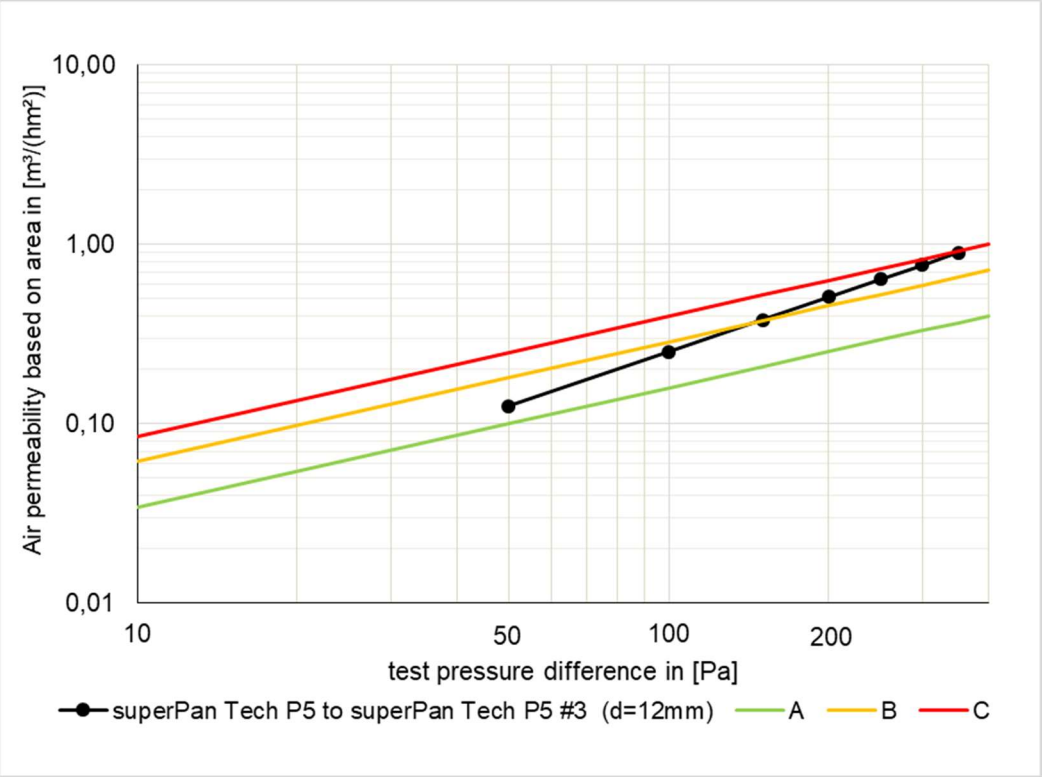

Fig. 18: **Series of measurements for the sample "Finsa superPan Tech P5 to Finsa superPan Tech P5 #3" (thickness= 12 mm). The certificate classes A to C according to the PHI are entered in addition.**

9.2.2 Engineered wood panel to engineered wood panel, thickness = 15 mm

Connection to	
Panel on its own	
Panel to panel	x
Panel to membrane	
Panel to concrete	

Table 6: Results of the three measurements with the panel to panel (thickness= 15 mm) connection using Sicrall®[2]

examined thickness	15,00 mm
examined area	1,72 m²

superPan Tech P5 to superPan Tech P5 #1 (d=15mm) bonded using Sicrall

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,21	0,40	0,57	0,75	0,92	1,09	1,25
test stand leakage	m³/h	0,06	0,09	0,11	0,14	0,16	0,18	0,19
specific air volume flow	m³/h	0,15	0,31	0,46	0,62	0,77	0,93	1,08
leakage volume flow based on area	m³/(h m²)	0,09	0,18	0,27	0,36	0,45	0,54	0,63

superPan Tech P5 to superPan Tech P5 #2 (d=15mm)

total volume flow	m³/h	0,16	0,30	0,43	0,56	0,68	0,81	0,93
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,11	0,13	0,14
specific air volume flow	m³/h	0,11	0,23	0,34	0,46	0,57	0,69	0,80
leakage volume flow based on area	m³/(h m²)	0,07	0,13	0,20	0,27	0,33	0,40	0,47

superPan Tech P5 to superPan Tech P5 #3 (d=15mm)

total volume flow	m³/h	0,21	0,40	0,58	0,76	0,94	1,11	1,28
test stand leakage	m³/h	0,06	0,08	0,10	0,12	0,14	0,15	0,16
specific air volume flow	m³/h	0,15	0,31	0,47	0,63	0,80	0,96	1,12
leakage volume flow based on area	m³/(h m²)	0,09	0,18	0,28	0,37	0,46	0,56	0,65

Average

Q50 (PHI - assessment) **0,08** m³/(h m²)

resulting in an airtightness class of **A** according to PHI Q50 ≤ 0,1

[2] The differences are due to rounding

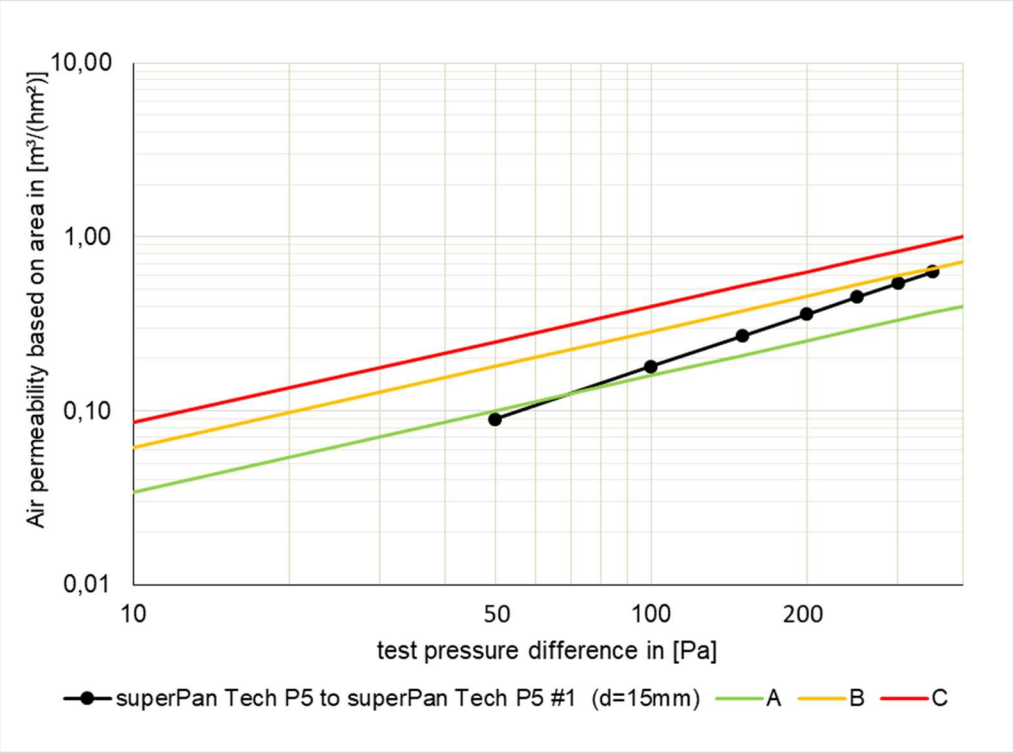

Fig. 19: **Series of measurements for the sample "Finsa superPan Tech P5 to Finsa superPan Tech P5 #1" (thickness= 15 mm). The certificate classes A to C according to the PHI are entered in addition.**

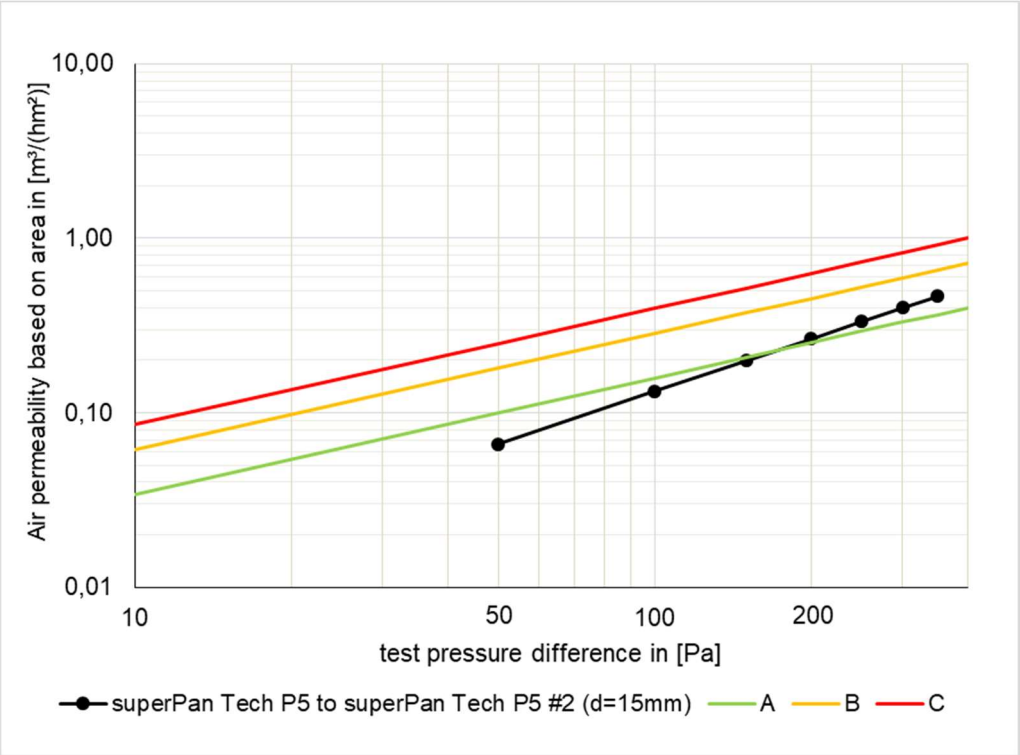

Fig. 20: **Series of measurements for the sample "Finsa superPan Tech P5 to Finsa superPan Tech P5 #2" (thickness= 15 mm). The certificate classes A to C according to the PHI are entered in addition.**

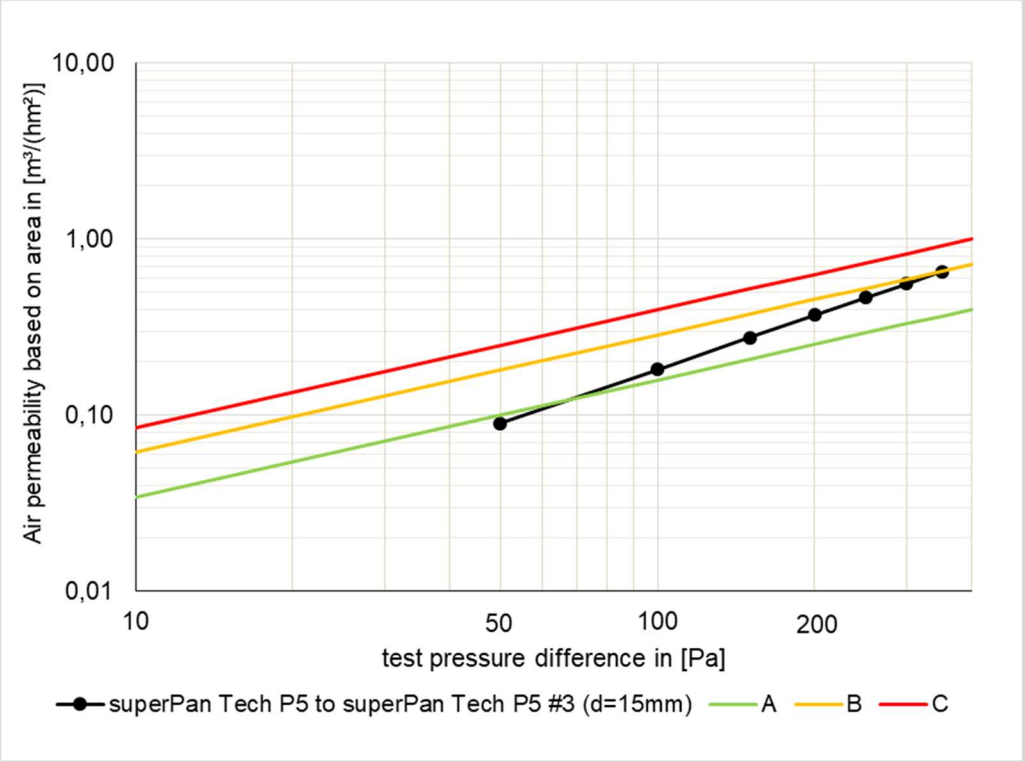

Fig. 21: **Series of measurements for the sample "Finsa superPan Tech P5 to Finsa superPan Tech P5 #3" (thickness= 15 mm). The certificate classes A to C according to the PHI are entered in addition.**

9.2.3 Engineered wood panel to engineered wood panel, thickness = 18 mm

Connection to	
Panel on its own	
Panel to panel	x
Panel to membrane	
Panel to concrete	

Table 7: Results of the three measurements with the panel to panel (thickness= 18 mm) connection using Sicrall®[3]

examined thickness	18,00 mm
examined area	1,72 m²

superPan Tech P5 to superPan Tech P5 #1 (d=18mm) bonded using Sicrall

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,21	0,38	0,54	0,69	0,84	0,98	1,12
test stand leakage	m³/h	0,04	0,07	0,09	0,11	0,12	0,14	0,15
specific air volume flow	m³/h	0,17	0,31	0,45	0,58	0,71	0,84	0,97
leakage volume flow based on area	m³/(h m²)	0,10	0,18	0,26	0,34	0,42	0,49	0,56

superPan Tech P5 to superPan Tech P5 #2 (d=18mm)

total volume flow	m³/h	0,16	0,30	0,43	0,56	0,68	0,81	0,93
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,11	0,13	0,14
specific air volume flow	m³/h	0,11	0,23	0,34	0,46	0,57	0,69	0,80
leakage volume flow based on area	m³/(h m²)	0,07	0,13	0,20	0,27	0,33	0,40	0,47

superPan Tech P5 to superPan Tech P5 #3 (d=18mm)

total volume flow	m³/h	0,15	0,29	0,42	0,55	0,67	0,79	0,91
test stand leakage	m³/h	0,05	0,08	0,09	0,11	0,13	0,14	0,15
specific air volume flow	m³/h	0,11	0,21	0,32	0,43	0,54	0,65	0,76
leakage volume flow based on area	m³/(h m²)	0,06	0,12	0,19	0,25	0,32	0,38	0,45

Average

Q50 (PHI - assessment) **0,07** m³/(h m²)

resulting in an airtightness class of **A** according to PHI Q50 ≤ 0,1

[3] The differences are due to rounding

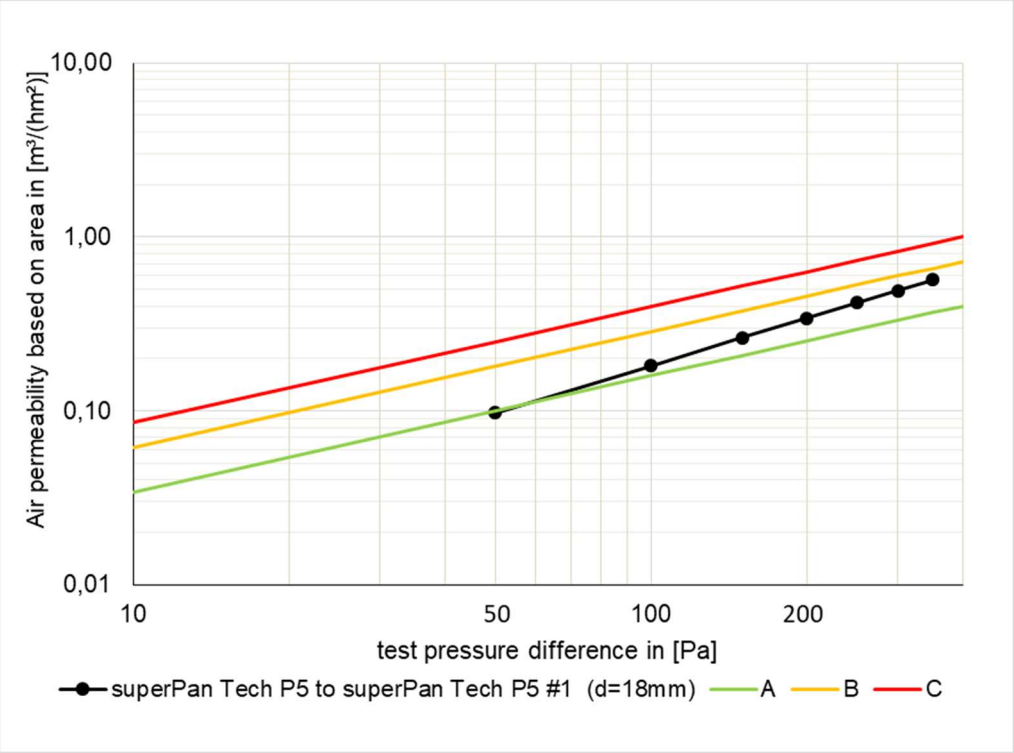

Fig. 22: **Series of measurements for the sample "Finsa superPan Tech P5 to Finsa superPan Tech P5 #1" (thickness= 18 mm). The certificate classes A to C according to the PHI are entered in addition.**

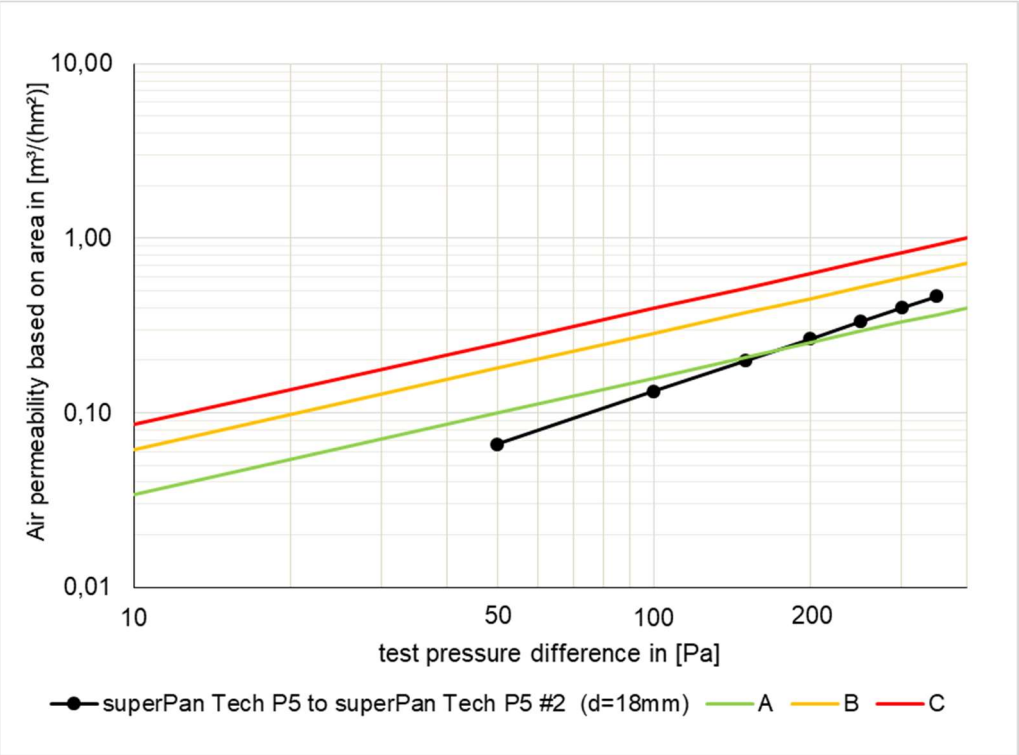

Fig. 23: **Series of measurements for the sample "Finsa superPan Tech P5 to Finsa superPan Tech P5 #2" (thickness= 18 mm). The certificate classes A to C according to the PHI are entered in addition.**

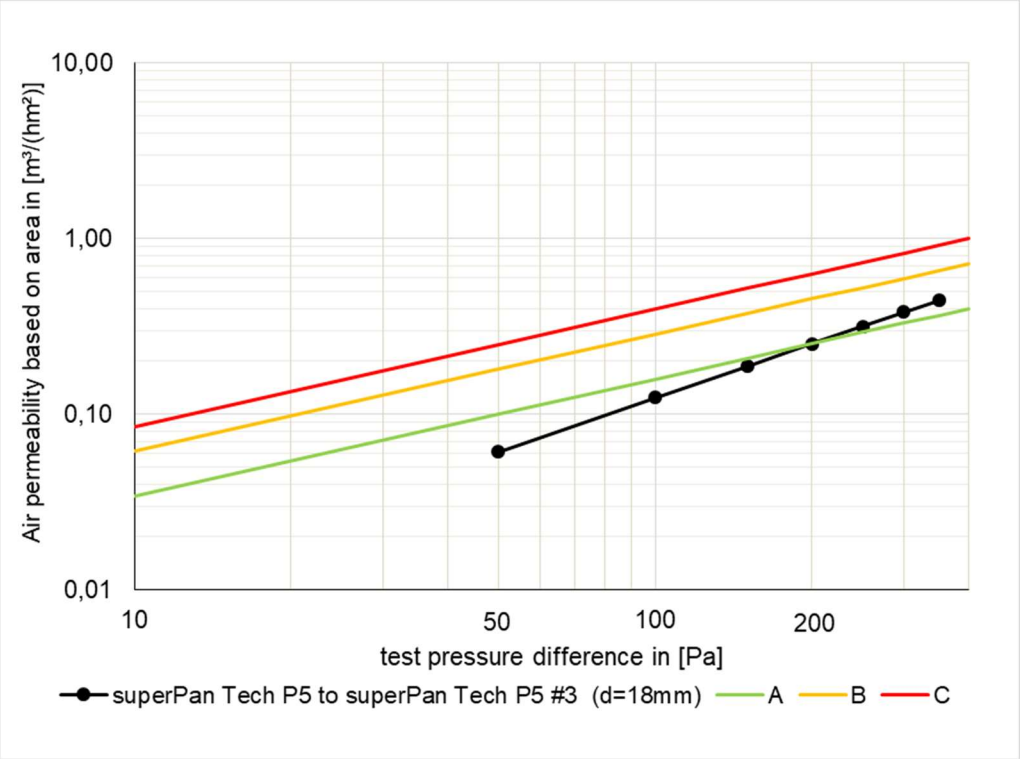

Fig. 24: **Series of measurements for the sample "Finsa superPan Tech P5 to Finsa superPan Tech P5 #3" (thickness= 18 mm). The certificate classes A to C according to the PHI are entered in addition.**

9.3 Panel to airtight membrane connection

9.3.1 Engineered wood panel (thickness= 12 mm) to airtight membrane

Connection to	
Panel on its own	
Panel to panel	
Panel to membrane	x
Panel to concrete	

Table 8: Results of the three measurements with the engineered wood panel (thickness= 12 mm) to airtight membrane connection using Sicrall®[4]

examined thickness	12,00 mm
examined area	1,48 m²

superPan Tech P5 to Bahn #1 (d=12mm) bonded using Sicrall

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,21	0,41	0,60	0,79	0,97	1,16	1,34
test stand leakage	m³/h	0,04	0,07	0,09	0,10	0,12	0,13	0,14
specific air volume flow	m³/h	0,17	0,34	0,51	0,69	0,86	1,04	1,21
leakage volume flow based on area	m³/(h m²)	0,11	0,23	0,35	0,46	0,58	0,70	0,82

superPan Tech P5 to Bahn #2 (d=12mm)

total volume flow	m³/h	0,22	0,42	0,61	0,80	0,99	1,18	1,37
test stand leakage	m³/h	0,04	0,06	0,07	0,09	0,10	0,11	0,12
specific air volume flow	m³/h	0,18	0,36	0,54	0,72	0,90	1,08	1,27
leakage volume flow based on area	m³/(h m²)	0,12	0,24	0,37	0,49	0,61	0,73	0,86

superPan Tech P5 to Bahn #3 (d=12mm)

total volume flow	m³/h	0,22	0,43	0,62	0,82	1,01	1,20	1,39
test stand leakage	m³/h	0,04	0,06	0,08	0,10	0,11	0,12	0,13
specific air volume flow	m³/h	0,18	0,36	0,55	0,73	0,91	1,09	1,28
leakage volume flow based on area	m³/(h m²)	0,12	0,25	0,37	0,49	0,62	0,74	0,87

Average

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

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

[4] The differences are due to rounding

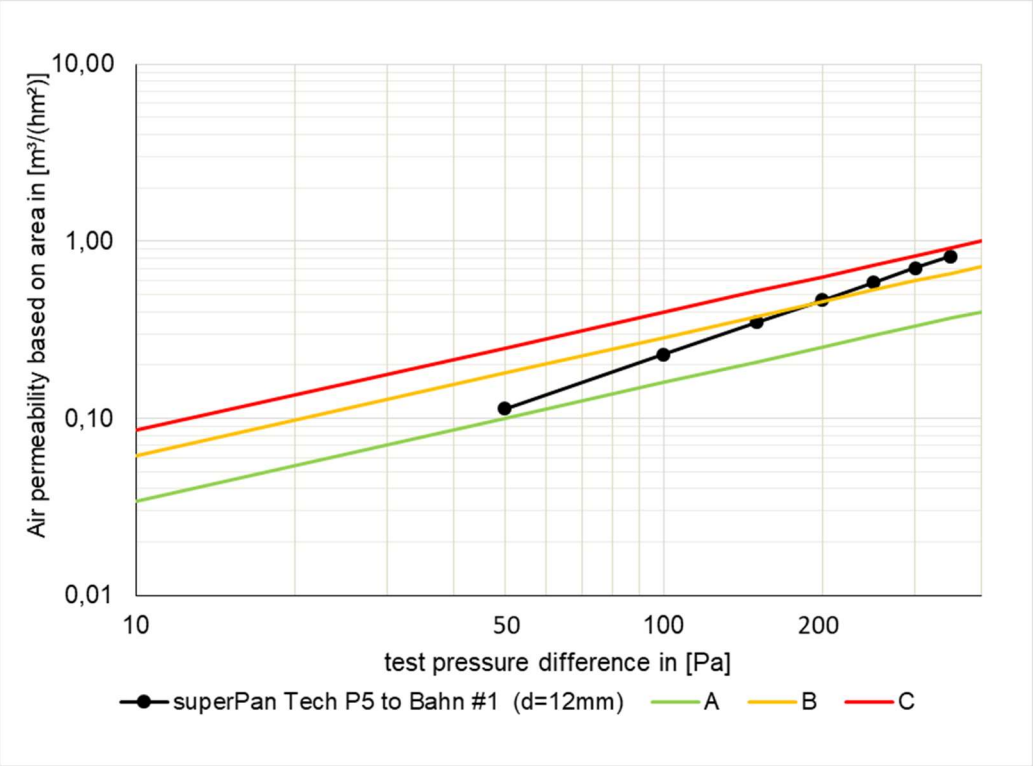

Fig. 25: **Series of measurements for the sample "Finsa superPan Tech P5 to airtight membrane #1" (thickness= 12 mm). The certificate classes A to C according to the PHI are entered in addition.**

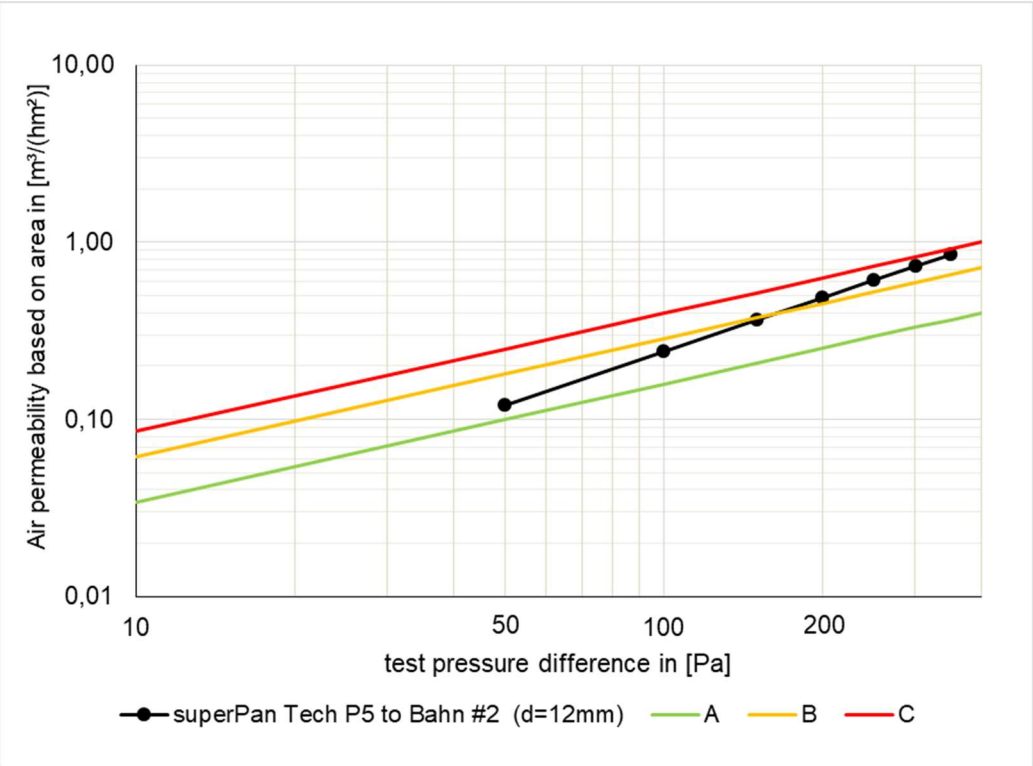

Fig. 26: **Series of measurements for the sample "Finsa superPan Tech P5 to airtight membrane #2" (thickness= 12 mm). The certificate classes A to C according to the PHI are entered in addition.**

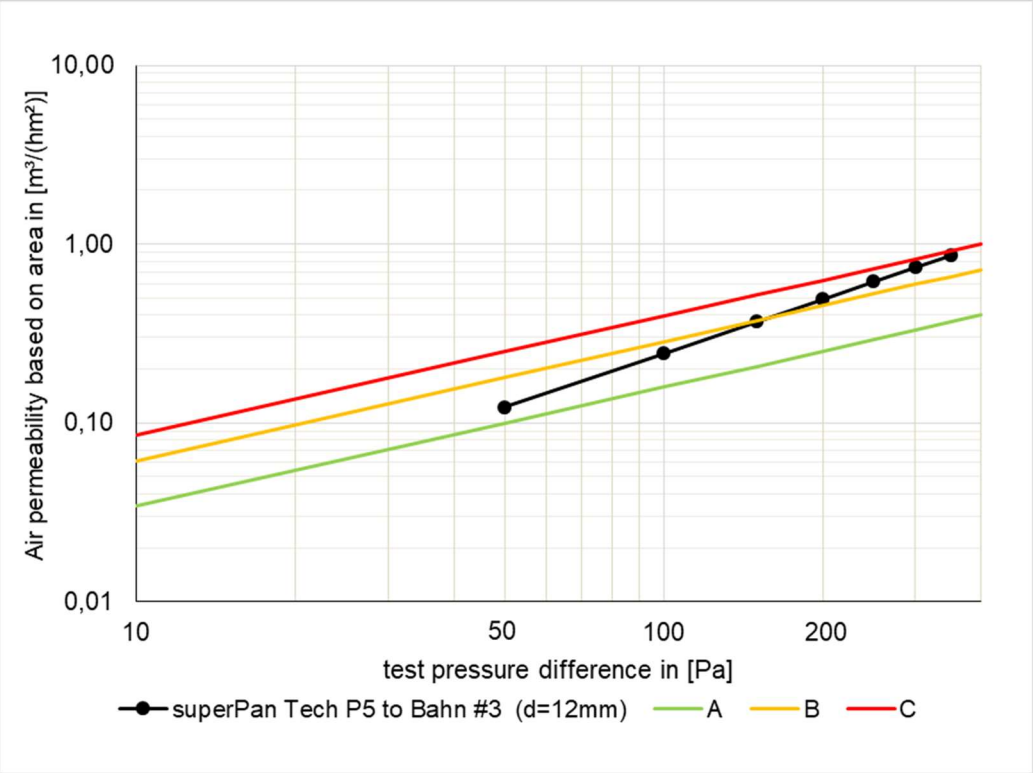

Fig. 27: **Series of measurements for the sample "Finsa superPan Tech P5 to airtight membrane #3" (thickness= 12 mm). The certificate classes A to C according to the PHI are entered in addition.**

9.3.2 Engineered wood panel (thickness= 15 mm) to airtight membrane

Connection to	
Panel on its own	
Panel to panel	
Panel to membrane	x
Panel to concrete	

Table 9: Results of the three measurements with the engineered wood panel (thickness= 15 mm) to airtight membrane connection using Sicrall®[5]

examined thickness	15,00 mm
examined area	1,48 m²

superPan Tech P5 to Bahn #1 (d=15mm) bonded using Sicrall

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,18	0,34	0,48	0,63	0,77	0,91	1,05
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,11	0,13	0,14
specific air volume flow	m³/h	0,13	0,26	0,40	0,53	0,66	0,79	0,92
leakage volume flow based on area	m³/(h m²)	0,09	0,18	0,27	0,36	0,45	0,54	0,62

superPan Tech P5 to Bahn #2 (d=15mm)

total volume flow	m³/h	0,16	0,31	0,45	0,59	0,72	0,86	0,99
test stand leakage	m³/h	0,05	0,07	0,09	0,11	0,13	0,14	0,16
specific air volume flow	m³/h	0,12	0,24	0,36	0,48	0,61	0,73	0,85
leakage volume flow based on area	m³/(h m²)	0,08	0,16	0,24	0,33	0,41	0,49	0,58

superPan Tech P5 to Bahn #3 (d=15mm)

total volume flow	m³/h	0,20	0,36	0,51	0,65	0,80	0,93	1,07
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,11	0,13	0,14
specific air volume flow	m³/h	0,15	0,28	0,41	0,54	0,67	0,80	0,92
leakage volume flow based on area	m³/(h m²)	0,10	0,19	0,28	0,37	0,46	0,54	0,63

Average

Q50 (PHI - assessment) **0,09** m³/(h m²)

resulting in an airtightness class of **A** according to PHI Q50 ≤ 0,1

[5] The differences are due to rounding

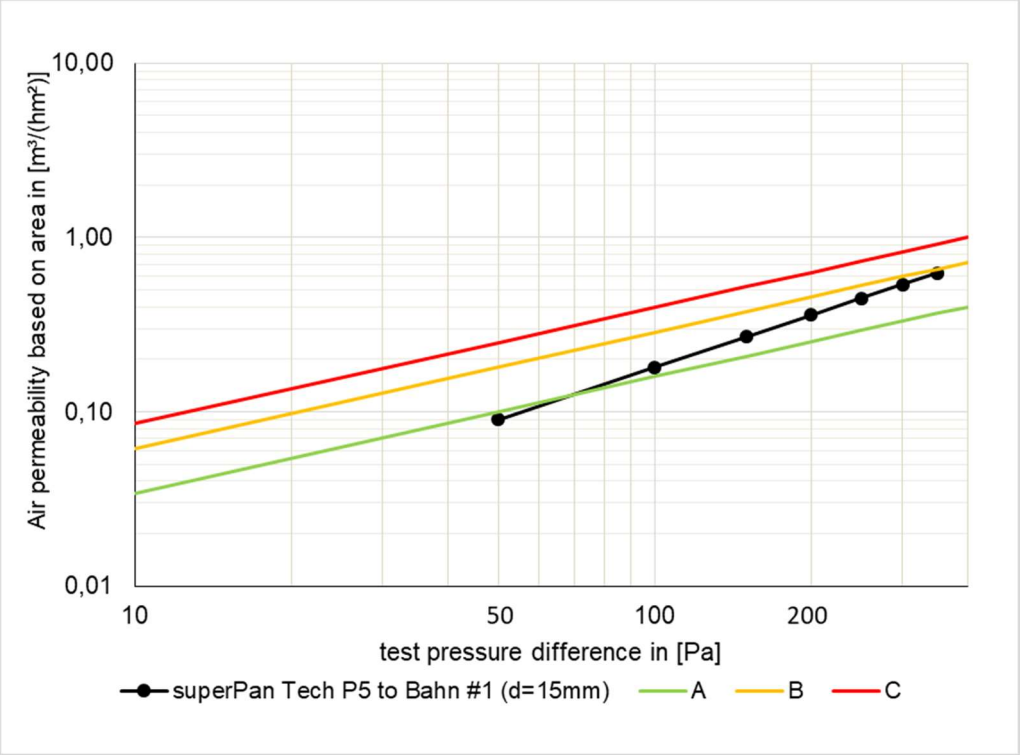

Fig. 28: **Series of measurements for the sample "Finsa superPan Tech P5 to airtight membrane #1" (thickness= 15 mm). The certificate classes A to C according to the PHI are entered in addition.**

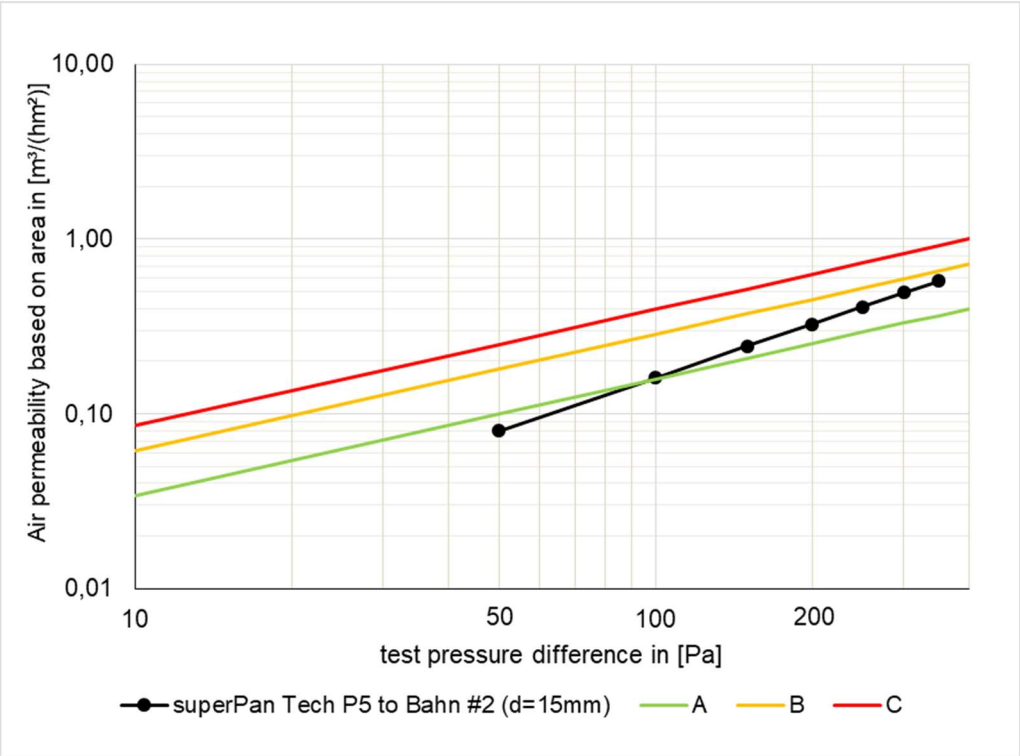

Fig. 29: **Series of measurements for the sample "Finsa superPan Tech P5 to airtight membrane #2" (thickness= 15 mm). The certificate classes A to C according to the PHI are entered in addition.**

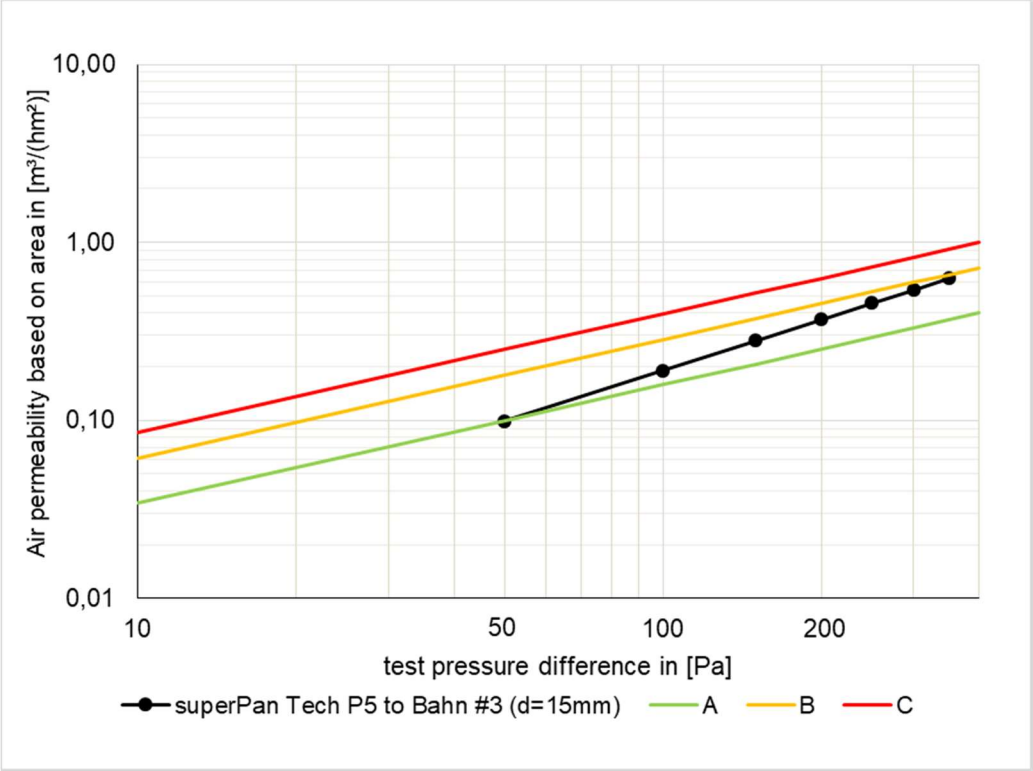

Fig. 30: **Series of measurements for the sample "Finsa superPan Tech P5 to airtight membrane #3" (thickness= 15 mm). The certificate classes A to C according to the PHI are entered in addition.**

9.3.3 Engineered wood panel (thickness= 18 mm) to airtight membrane

Connection to	
Panel on its own	
Panel to panel	
Panel to membrane	x
Panel to concrete	

Table 10: Results of the three measurements with the engineered wood panel (thickness= 18 mm) to airtight membrane connection using Sicrall®[6]

examined thickness	18,00 mm
examined area	1,48 m²

superPan Tech P5 to Bahn #1 (d=18mm) bonded using Sicrall

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,14	0,26	0,37	0,47	0,57	0,67	0,77
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,12	0,13	0,14
specific air volume flow	m³/h	0,09	0,18	0,27	0,36	0,45	0,54	0,63
leakage volume flow based on area	m³/(h m²)	0,06	0,12	0,18	0,25	0,31	0,37	0,43

superPan Tech P5 to Bahn #2 (d=18mm)

total volume flow	m³/h	0,14	0,26	0,38	0,49	0,59	0,70	0,80
test stand leakage	m³/h	0,05	0,07	0,08	0,10	0,11	0,12	0,13
specific air volume flow	m³/h	0,10	0,19	0,29	0,38	0,48	0,58	0,67
leakage volume flow based on area	m³/(h m²)	0,06	0,13	0,19	0,26	0,33	0,39	0,46

superPan Tech P5 to Bahn #3 (d=18mm)

total volume flow	m³/h	0,14	0,26	0,37	0,48	0,59	0,69	0,79
test stand leakage	m³/h	0,04	0,07	0,08	0,10	0,11	0,12	0,13
specific air volume flow	m³/h	0,09	0,19	0,28	0,37	0,46	0,56	0,65
leakage volume flow based on area	m³/(h m²)	0,06	0,13	0,19	0,25	0,31	0,38	0,44

Average

Q50 (PHI - assessment) **0,06** m³/(h m²)

resulting in an airtightness class of **A** according to PHI Q50 ≤ 0,1

[6] The differences are due to rounding

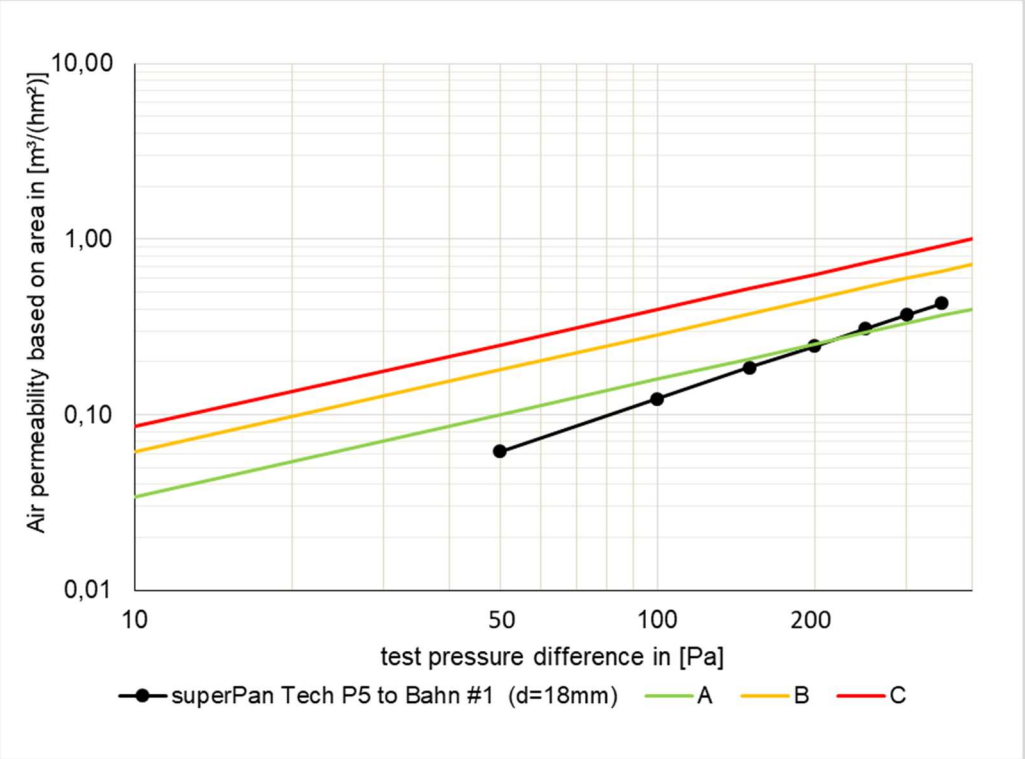

Fig. 31: **Series of measurements for the sample "Finsa superPan Tech P5 to airtight membrane #1" (thickness= 18 mm). The certificate classes A to C according to the PHI are entered in addition.**

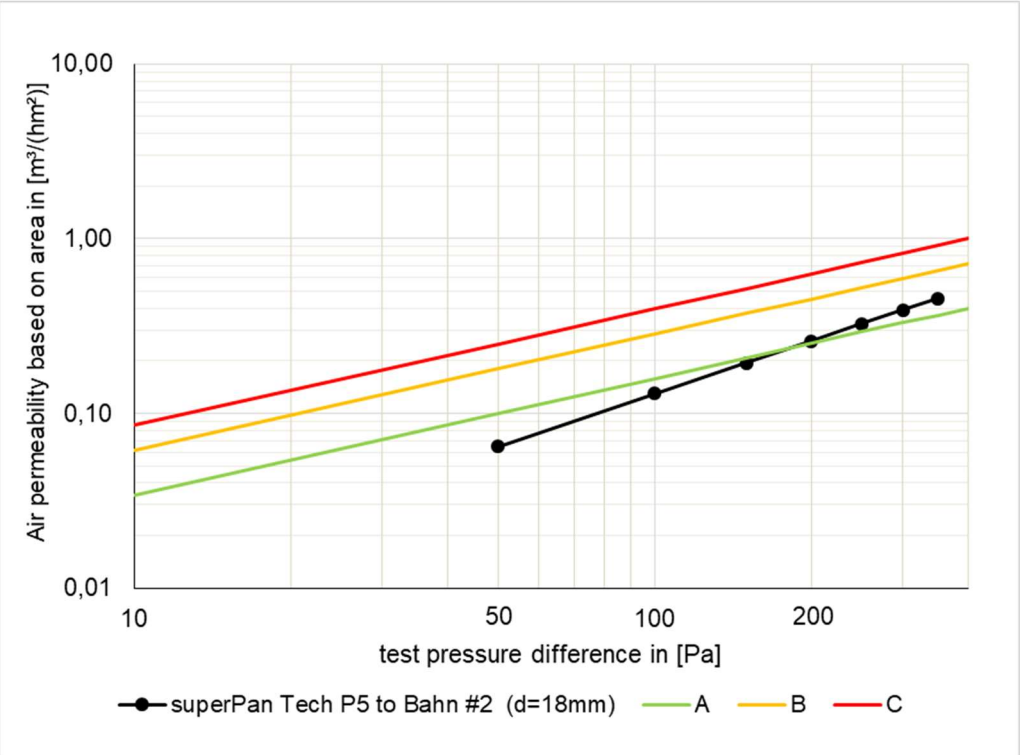

Fig. 32: **Series of measurements for the sample "Finsa superPan Tech P5 to airtight membrane #2" (thickness= 18 mm). The certificate classes A to C according to the PHI are entered in addition.**

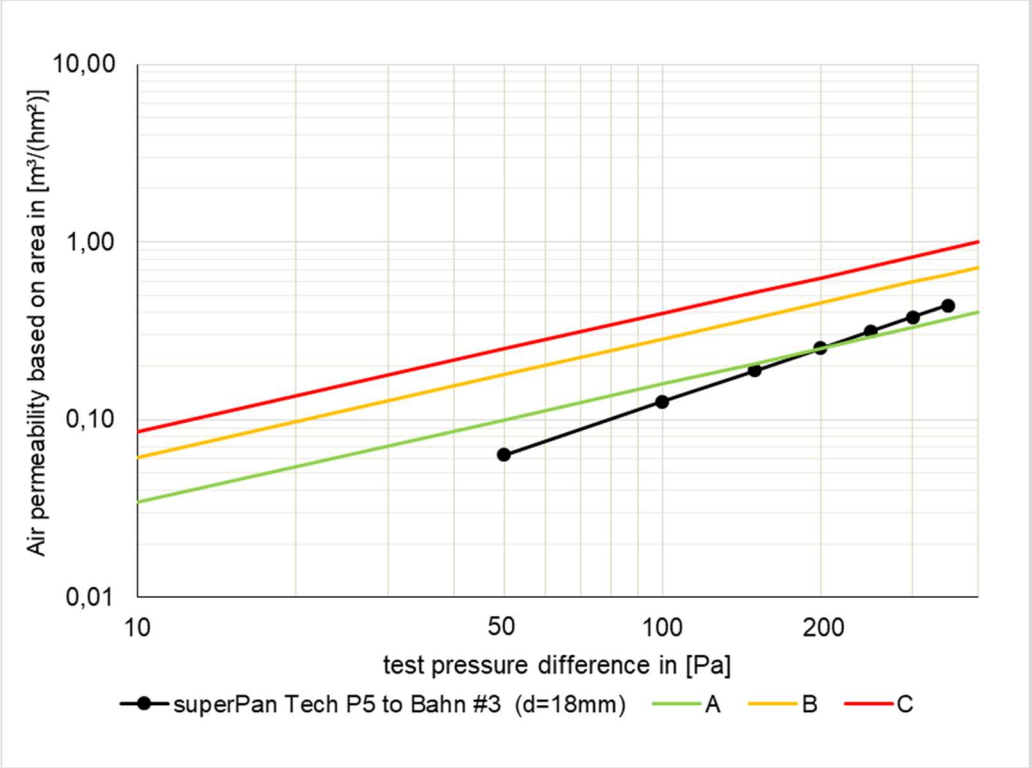

Fig. 33: **Series of measurements for the sample "Finsa superPan Tech P5 to airtight membrane #3" (thickness= 18 mm). The certificate classes A to C according to the PHI are entered in addition.**

9.4 Panel to concrete

9.4.1 Engineered wood panel (thickness= 12 mm) to concrete

Connection to	
Panel on its own	
Panel to panel	
Panel to membrane	
Panel to concrete	x

Table 11: Results of the three measurements with the engineered wood panel (thickness= 12 mm) to concrete connection using Fentrim®[7]

examined thickness	12,00 mm
examined area	1,48 m²

superPan Tech P5 to concrete #1 (d=12mm) bonded using Fentrim 20 50/85

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,25	0,48	0,70	0,91	1,12	1,33	1,54
test stand leakage	m³/h	0,05	0,07	0,08	0,10	0,11	0,12	0,13
specific air volume flow	m³/h	0,20	0,40	0,61	0,81	1,01	1,21	1,42
leakage volume flow based on area	m³/(h m²)	0,14	0,27	0,41	0,55	0,69	0,82	0,96

superPan Tech P5 to concrete #2 (d=12mm)

total volume flow	m³/h	0,26	0,50	0,72	0,94	1,15	1,36	1,57
test stand leakage	m³/h	0,05	0,07	0,09	0,11	0,13	0,14	0,15
specific air volume flow	m³/h	0,21	0,42	0,62	0,82	1,02	1,22	1,42
leakage volume flow based on area	m³/(h m²)	0,14	0,28	0,42	0,56	0,69	0,83	0,96

superPan Tech P5 to concrete #3 (d=12mm)

total volume flow	m³/h	0,36	0,63	0,87	1,10	1,32	1,53	1,73
test stand leakage	m³/h	0,04	0,06	0,07	0,09	0,10	0,11	0,13
specific air volume flow	m³/h	0,32	0,57	0,79	1,01	1,21	1,41	1,61
leakage volume flow based on area	m³/(h m²)	0,22	0,38	0,54	0,68	0,82	0,96	1,09

Average

Q50 (PHI - assessment) **0,17** m³/(h m²)

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

[7] The differences are due to rounding

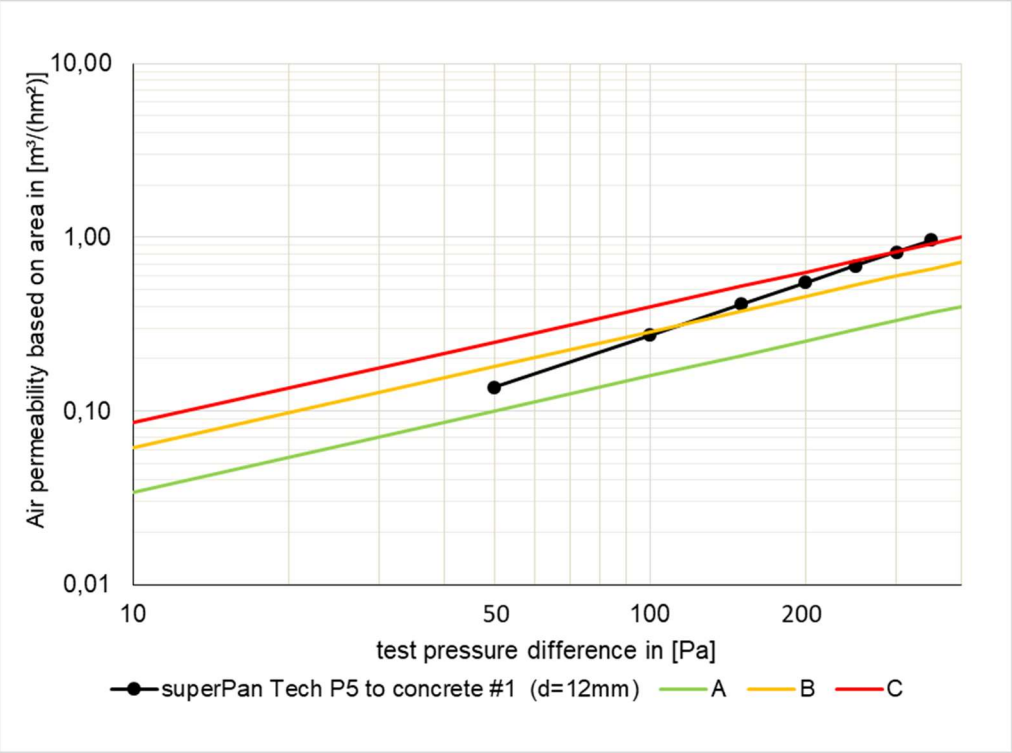

Fig. 34: **Series of measurements for the sample "Finsa superPan Tech P5 to concrete #1" (thickness= 12 mm). The certificate classes A to C according to the PHI are entered in addition.**

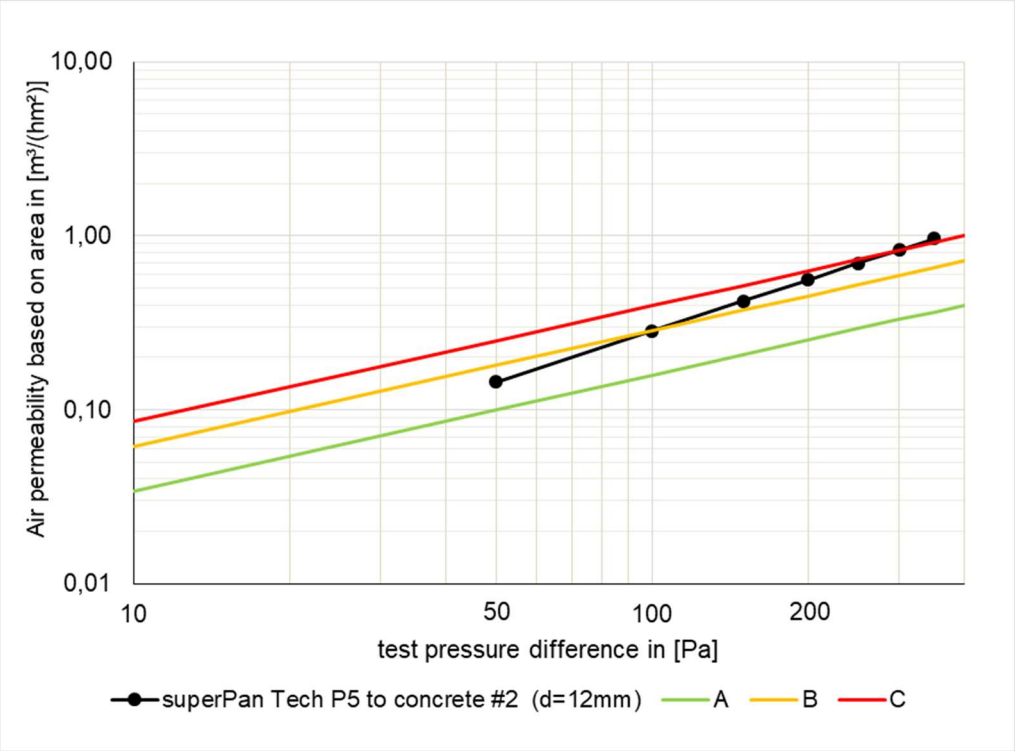

Fig. 35: **Series of measurements for the sample "Finsa superPan Tech P5 to concrete #2" (thickness= 12 mm). The certificate classes A to C according to the PHI are entered in addition.**

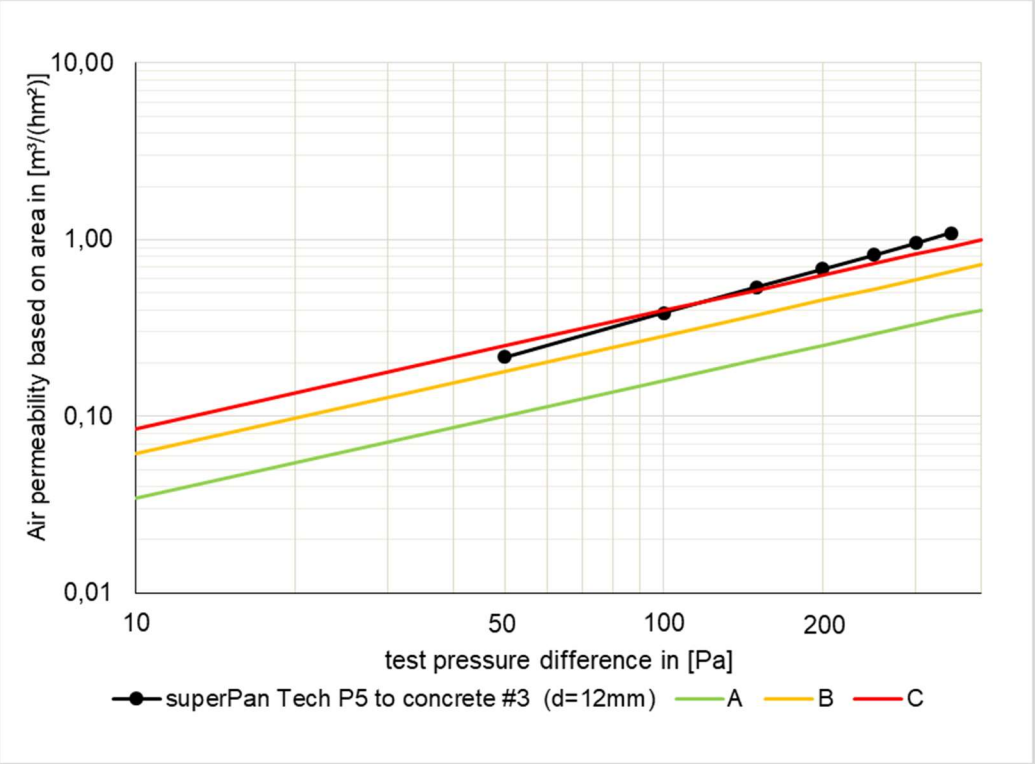

Fig. 36: **Series of measurements for the sample "Finsa superPan Tech P5 to concrete #3" (thickness= 12 mm). The certificate classes A to C according to the PHI are entered in addition.**

9.4.2 Engineered wood panel (thickness= 15 mm) to concrete

Connection to	
Panel on its own	
Panel to panel	
Panel to membrane	
Panel to concrete	x

Table 12: Results of the three measurements with the engineered wood panel (thickness= 15 mm) to concrete connection using Fentrim®[8]

examined thickness	15,00 mm
examined area	1,48 m²

superPan Tech P5 to concrete #1 (d=15mm) bonded using Fentrim 20 50/85

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,18	0,35	0,52	0,68	0,83	0,99	1,14
test stand leakage	m³/h	0,04	0,06	0,08	0,10	0,12	0,14	0,15
specific air volume flow	m³/h	0,14	0,29	0,43	0,57	0,72	0,86	1,00
leakage volume flow based on area	m³/(h m²)	0,10	0,19	0,29	0,39	0,49	0,58	0,68

superPan Tech P5 to concrete #2 (d=15mm)

total volume flow	m³/h	0,18	0,34	0,50	0,65	0,80	0,95	1,10
test stand leakage	m³/h	0,04	0,06	0,08	0,09	0,10	0,12	0,13
specific air volume flow	m³/h	0,14	0,28	0,42	0,56	0,70	0,84	0,99
leakage volume flow based on area	m³/(h m²)	0,09	0,19	0,28	0,38	0,47	0,57	0,67

superPan Tech P5 to concrete #3 (d=15mm)

total volume flow	m³/h	0,18	0,34	0,49	0,64	0,79	0,94	1,09
test stand leakage	m³/h	0,04	0,07	0,09	0,10	0,12	0,13	0,14
specific air volume flow	m³/h	0,13	0,27	0,41	0,55	0,69	0,83	0,97
leakage volume flow based on area	m³/(h m²)	0,09	0,18	0,28	0,37	0,47	0,56	0,66

Average

Q50 (PHI - assessment) **0,09** m³/(h m²)

resulting in an airtightness class of **A** according to PHI Q50 ≤ 0,1

[8] The differences are due to rounding

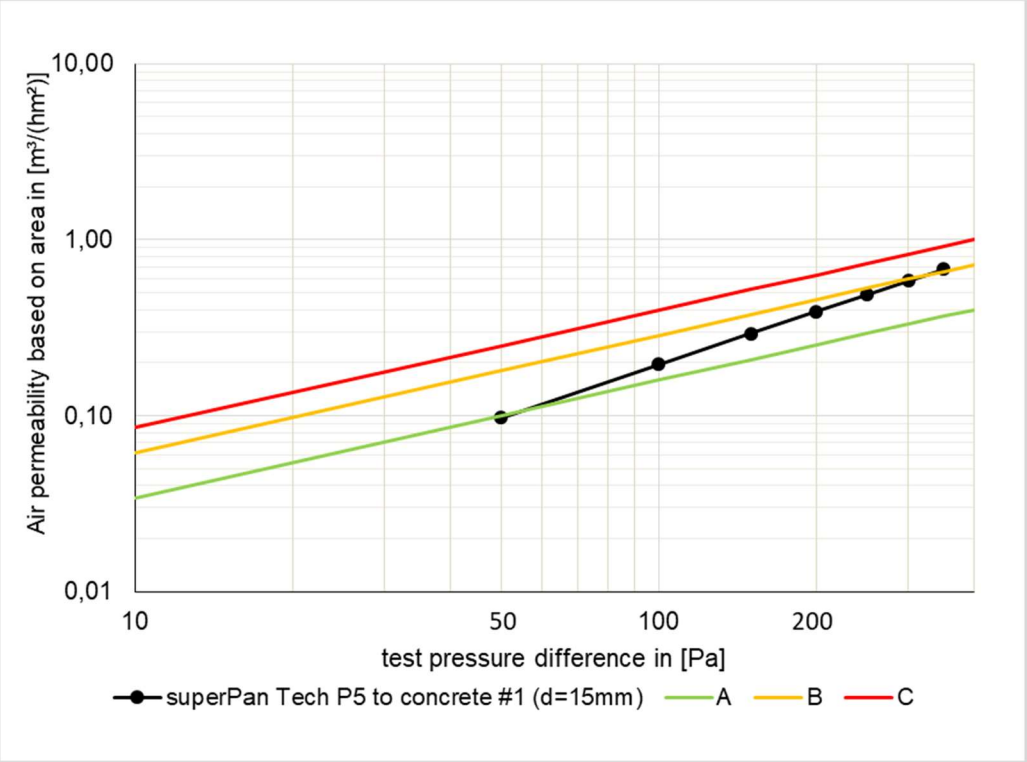

Fig. 37: **Series of measurements for the sample "Finsa superPan Tech P5 to concrete #1" (thickness= 15 mm). The certificate classes A to C according to the PHI are entered in addition.**

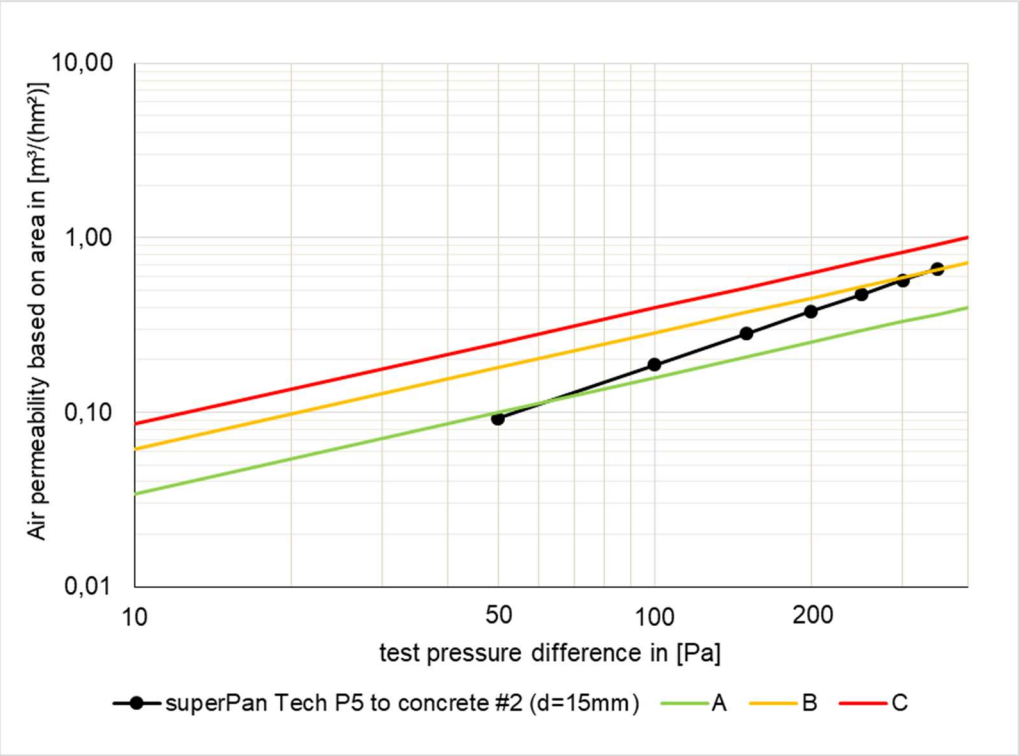

Fig. 38: **Series of measurements for the sample "Finsa superPan Tech P5 to concrete #2" (thickness= 15 mm). The certificate classes A to C according to the PHI are entered in addition.**

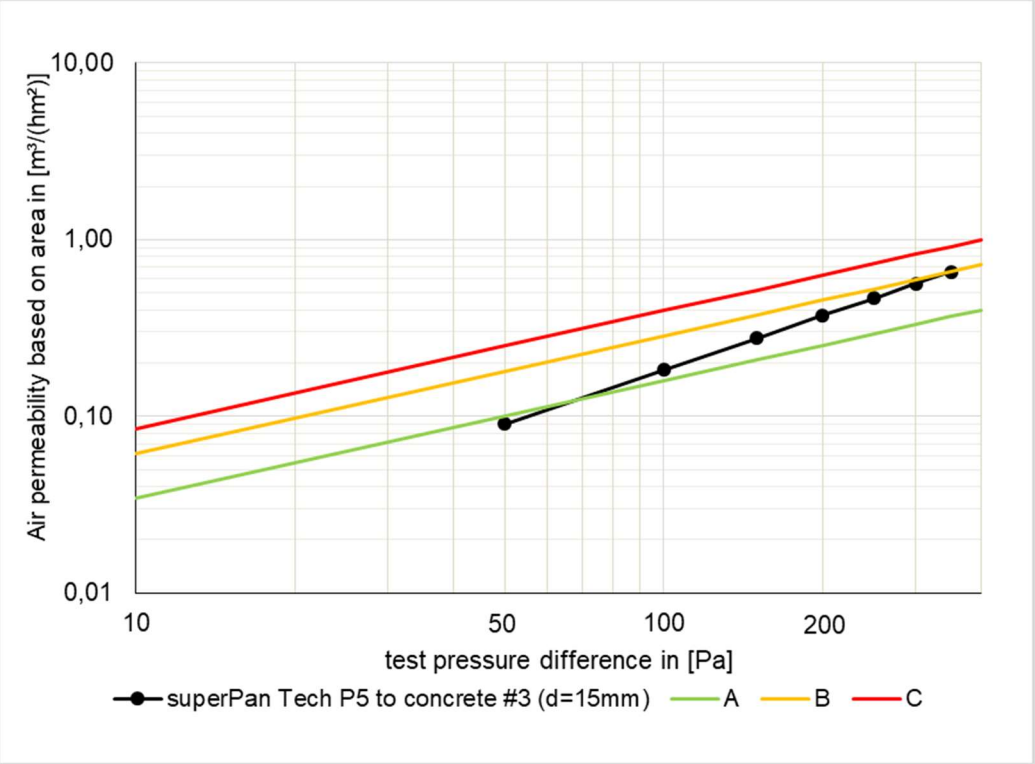

Fig. 39: **Series of measurements for the sample "Finsa superPan Tech P5 to concrete #3" (thickness= 15 mm). The certificate classes A to C according to the PHI are entered in addition.**

9.4.3 Engineered wood panel (thickness= 18 mm) to concrete

Connection to	
Panel on its own	
Panel to panel	
Panel to membrane	
Panel to concrete	x

Table 13: Results of the three measurements with the engineered wood panel (d=18 mm) to concrete connection using Fentrim®[9]

examined thickness	18,00 mm
examined area	1,48 m²

superPan Tech P5 to concrete #1 (d=18mm) bonded using Fentrim 20 50/85

Pressure stages	Pa	50	100	150	200	250	300	350
total volume flow	m³/h	0,18	0,33	0,48	0,62	0,76	0,89	1,03
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,12	0,13	0,14
specific air volume flow	m³/h	0,12	0,25	0,38	0,51	0,64	0,77	0,90
leakage volume flow based on area	m³/(h m²)	0,08	0,17	0,26	0,34	0,43	0,52	0,61

superPan Tech P5 to concrete #2 (d=18mm)

total volume flow	m³/h	0,20	0,38	0,55	0,72	0,89	1,06	1,22
test stand leakage	m³/h	0,05	0,07	0,08	0,10	0,11	0,12	0,13
specific air volume flow	m³/h	0,15	0,31	0,47	0,63	0,79	0,95	1,11
leakage volume flow based on area	m³/(h m²)	0,10	0,21	0,32	0,43	0,53	0,64	0,75

superPan Tech P5 to concrete #3 (d=18mm)

total volume flow	m³/h	0,15	0,29	0,41	0,53	0,65	0,77	0,88
test stand leakage	m³/h	0,05	0,07	0,09	0,10	0,11	0,13	0,14
specific air volume flow	m³/h	0,11	0,21	0,32	0,42	0,53	0,63	0,74
leakage volume flow based on area	m³/(h m²)	0,07	0,14	0,22	0,29	0,36	0,43	0,50

Average

Q50 (PHI - assessment) **0,09** m³/(h m²)

resulting in an airtightness class of **A** according to PHI Q50 ≤ 0,1

[9] The differences are due to rounding

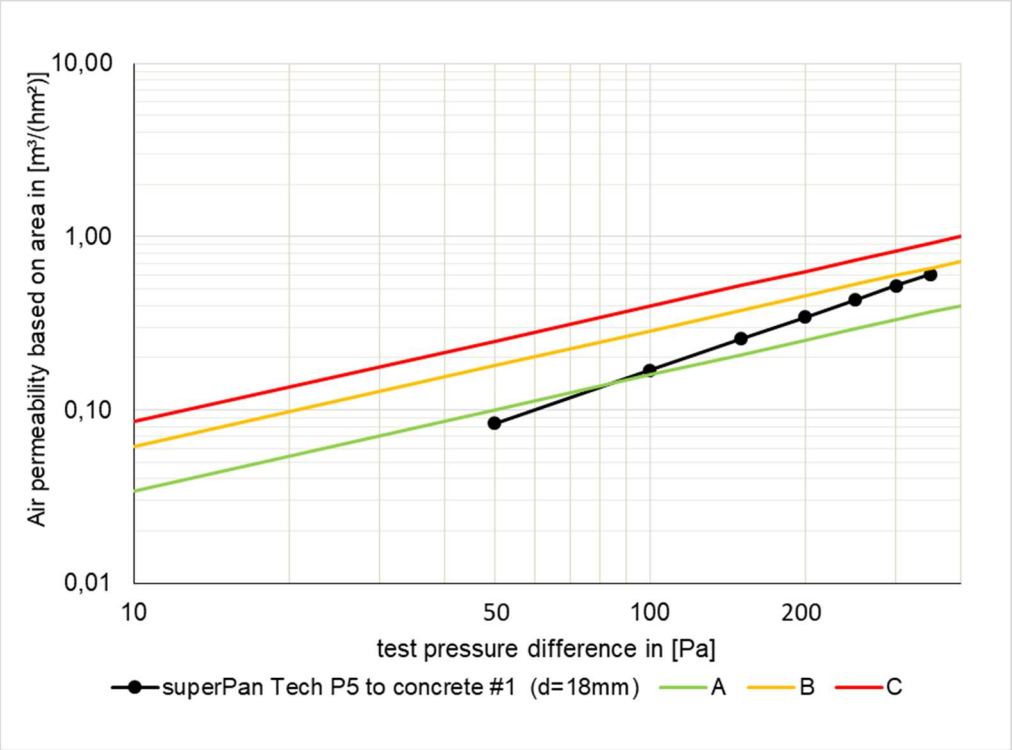

Fig. 40: **Series of measurements for the sample "Finsa superPan Tech P5 to concrete #1" (thickness= 18 mm). The certificate classes A to C according to the PHI are entered in addition.**

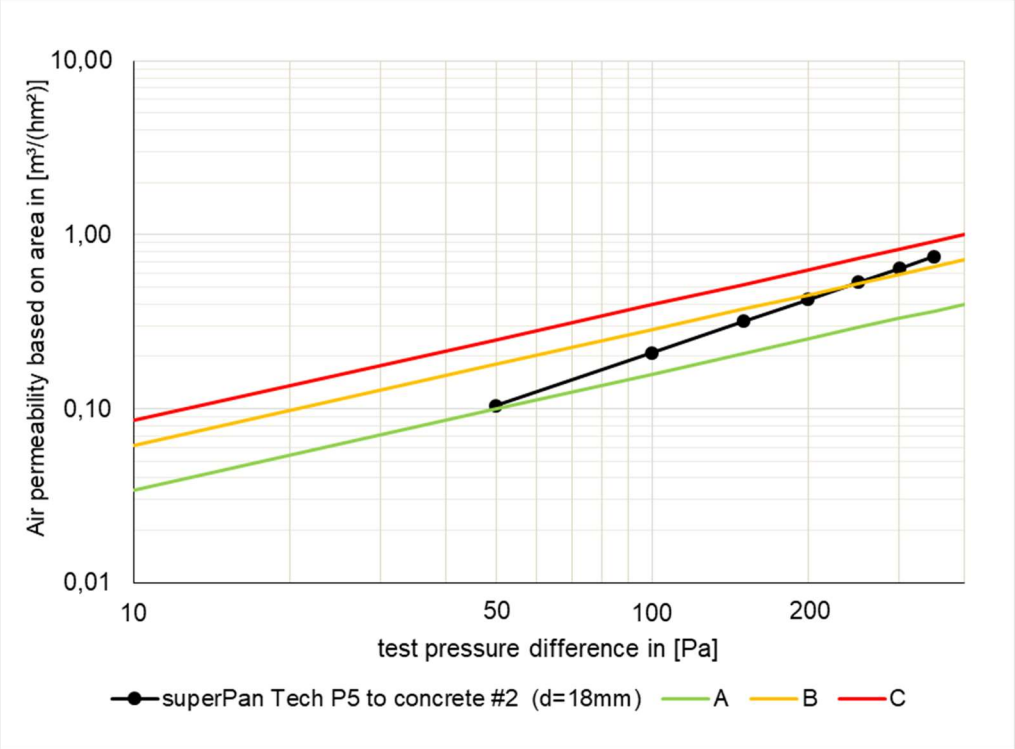

Fig. 41: **Series of measurements for the sample "Finsa superPan Tech P5 to concrete #2" (thickness= 15 mm). The certificate classes A to C according to the PHI are entered in addition.**

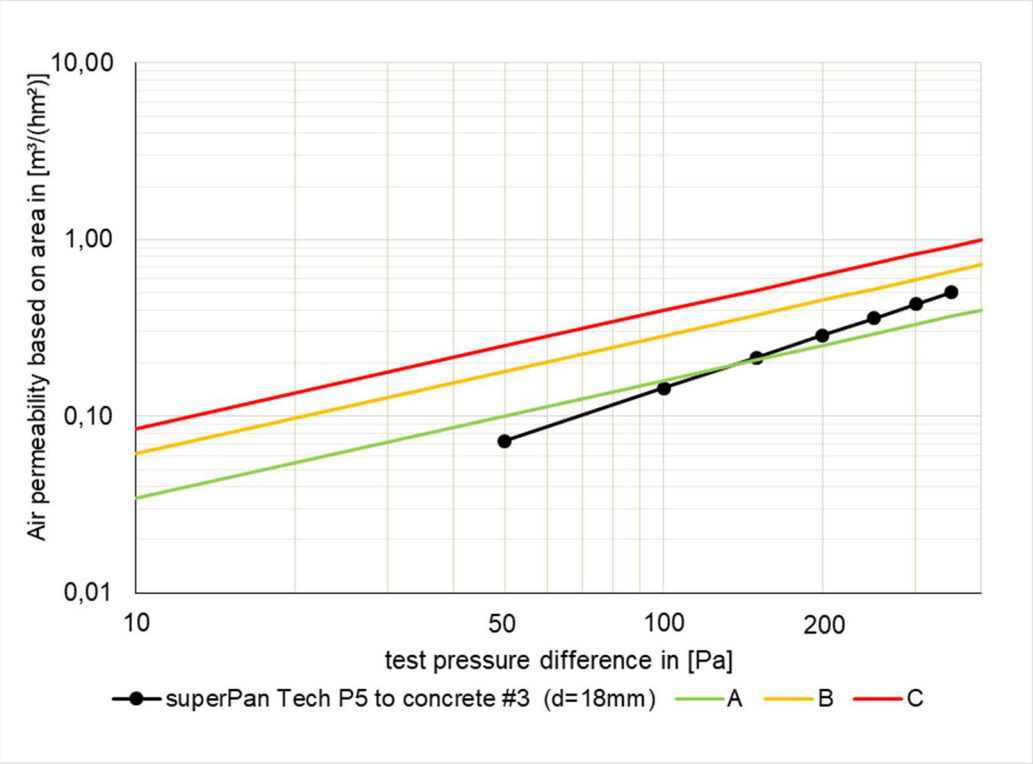

Fig. 42: **Series of measurements for the sample "Finsa superPan Tech P5 to concrete #3" (thickness= 18 mm). The certificate classes A to C according to the PHI are entered in addition.**

10. Test conditions

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

Indoor temperature: 22.3 °C
Indoor air humidity: 42.8 % r.H.

11. 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 14: 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 %

12. Results

The results of these measurements were compiled and the overall average value was generated according to the panel thicknesses and type of connection. In doing so, the measured value for the engineered wood panel on its own (without any connection) was not taken into account because this concerns certification as a system and not material testing alone. Accordingly, different average values resulted for the different panel thicknesses: panels with a thickness of 12 mm achieved Class ph**B**, panels with thicknesses of 15 mm and 18 mm achieved Class ph**A**.

12.1 Result for panel thickness = 12 mm

Table 15: Overview of the airtightness measurement for panels with a thickness of 12 mm

Average value of	m³/(hm²) @ 50 Pa
Panel to panel	0.13
Panel to membrane	0.17
Panel to concrete	0.12
Overall	**0.14 (±0.004)**

Table 16: Requirement class achieved by the examined product with a thickness of 12 mm for certification as an "Airtightness system window connection" according to Passive House Institute specifications

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

12.2 Result for panel thickness = 15 mm

Table 17: Overview of the airtightness measurement for panels with a thickness of 15 mm

Average value of	m³/(hm²) @ 50 Pa
Panel to panel	0.09
Panel to membrane	0.09
Panel to concrete	0.09
Overall	**0.09 (±0.003)**

Table 18: Requirement class achieved by the examined product with a thickness of 15 mm for certification as an "Airtightness system window connection" according to Passive House Institute specifications

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

12.3 Result for panel thickness = 18 mm

Table 19: Overview of the airtightness measurement for panels with a thickness of 18 mm

Average value of	m³/(hm²) @ 50 Pa
Panel to panel	0.07
Panel to membrane	0.09
Panel to concrete	0.06
Overall	**0.07 (±0.003)**

Table 20: Requirement class achieved by the examined product with a thickness of 18 mm for certification as an "Airtightness system window connection" according to Passive House Institute specifications

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, 14.08.2017

Søren Peper

Søren Peper