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TEST REPORT NO. 812.156.024.100

APPLICANT: Stora Enso Wood Products GmbH Ybbs
Bahnhofstraße 31
3370 Ybbs, Austria

APPLICATION: Air permeability test on a test object in accordance with ÖNORM EN 1026 and ÖNORM EN 12114.

TEST OBJECT: Laminated timber plates delivered by the applicant and consisting of bonded board lamellas arranged at right angles to one another, identified as "**CLT 100 NVI 3s**"; a vertical stepped rebate, a vertical butt joint, installation grooves visible on room side.
Design: see page 2, "Test object".

DATE: 10.06.2013

TEST REPORT CONTENT:

1 Application
2 Test object
3 Test
4 Test results
5 Test report validity
Enclosure 1 Diagram of test bench and attachment of test object to test bench
Enclosure 2 Test certificate – EN 12207
Enclosure 3 Test certificate – EN 12114
Enclosure 4 Layout

SCOPE OF THE TEST REPORT: 17 pages (A4 format) including enclosures

Notifiziert als Prüf- und Überwachungsstelle gemäß Art. 18 Bauproduktenrichtlinie 89/106/EWG vom 21.12.1988 unter der Nr. 2064

Akkreditiert nach EN ISO 17025 als Prüf- & Überwachungsstelle durch das Österreichische Institut für Bautechnik mit Bescheid OIB-160-004/02-004

Akkreditiert nach dem Steiermärkischen Akkreditierungsgesetz LGBl. Nr. 62 / 1995

1 APPLICATION

Air permeability test on a test object in accordance with ÖNORM EN 1026 and ÖNORM EN 12114.

2 TEST OBJECT

Laminated timber plates delivered by the applicant consisting of bonded board lamellas arranged at right angles to one another, identified as "**CLT 100 NVI 3s**"; a vertical stepped rebate, a vertical butt joint, installation grooves visible on room side.
Design: see page 2, "Test object".

The front sides were tightly sealed so that air could only pass through the test object as normal.
Design according to the applicant's information:

Design starting from the outside
30 mm longitudinal direction (30/140 to 250)
40 mm transverse direction (40/140 to 250)
30 mm longitudinal direction (30/120 to 210)
Full surfaces glued underneath one another, bonding of narrow edges.
Two flush-mounted socket grooves in the room side and central board layers (d = 50 mm, t = 68 mm), one cable groove (d = 50 mm, w = 20 mm, l = 60 mm), continuing second cable groove (d = 20 mm, w = 20 mm, l = 250 mm).
Vertical stepped rebate sealed with 15/3 mm Compriband and bolted with screws – e = 30 cm.
Vertical head joint on room side, sealed with butt joint 27/148 mm with two plies of 15/3 mm Compriband and crosswise screws – e = 20 cm.
Evaluated test surface: 1975 × 1975 mm – 3.90 m²
Joint length: 5.78 m (with regard to the room side stepped rebate joint length and the two butt joint lengths)
Mass: ~ 54–56 kg/m² (depending on moisture content)

Test condition A:
Average timber moisture content: ~ 11.4% – test date: 07.02.2013

Test condition B:
Average timber moisture content: ~ 13.6% – test date: 17.02.2013

Test condition C:
Average timber moisture content: ~ 8.3% – test date: 25.04.2013

Test condition D:
Average timber moisture content: ~ 12.0% – test date: 17.05.2013

3 TEST

3.1 TEST BENCH

The test bench consists of a plumb-vertical test plate with fixed and mobile side walls arranged, as normal, perpendicularly and horizontally to the test plate to form a box which is open to the front. The test element is pressed without deformation onto the open front side of this box by means of threaded spindles and compressed air cylinders.
Pressure-controlled air is blown by a radial fan or compressor into the box through an opening on the rear side to test air permeability, behaviour when subjected to wind pressure and impermeability to driving rain. Parallel spray pipes equipped with full cone nozzles are installed in the box in accordance with ÖNORM EN 1027 to test impermeability to driving rain.
Measurement of the test pressure difference compared to atmospheric air pressure is performed using cascaded membrane pressure sensors. Air and water quantities are measured with floating cone measuring cylinders.

3.2 TEST SITE

Laboratory for building physics, Inffeldgasse 24, 8010 Graz, Austria.

3.3 TEST DATE

See page 2.

3.4 BASIC PRINCIPLES

Test standards:
- ÖNORM EN 1026: Windows and doors – Air permeability – Test method
- ÖNORM EN 12114: Thermal performance of buildings – Air permeability of building components and building elements – Laboratory test methods

Classification standards:
- ÖNORM EN 12207: Windows and doors – Air permeability – Classification
- ÖNORM EN 12114: Thermal performance of buildings – Air permeability of building components and building elements – Laboratory test methods

The measurement and evaluation were performed in accordance with the specifications of the abovementioned standards in the currently applicable version.

Boundary conditions:	in accordance with the standard requirements
Deviations:	none
Air temperature:	21–22 °C
Relative humidity:	29–51%
Air pressure:	91.599–97.675 kPa
Lowest pressure difference:	50 Pa
Highest pressure difference:	500 Pa (EN 12114); 600 Pa (EN 1026)

3.4.1 AIR PERMEABILITY TEST ACCORDING TO EN 1026

The air permeability test was performed in accordance with ÖNORM EN 1026. Before the air permeability test, the inside of the test object which was turned away from the test bench was covered with a polyethylene film. In this condition, the air permeability measurement shows that air passes through leakages in the system used to clamp the test object to the test bench. The polyethylene film was then cut away and air permeability was measured under a test pressure of up to 600 Pa. The passage of air through the clamping system's

leakages was subtracted from the measured data obtained in this way. By comparing the worst reading of the length-based air permeability test with the limit curve for the stress classes, the achieved load class is determined in accordance with ÖNORM EN 12207.

3.4.2 AIR PERMEABILITY TEST ACCORDING TO EN 12114

The air permeability test was selected in accordance with ÖNORM EN 12114 with the largest pressure difference Δp_{max} determined with 500 Pa. The smallest pressure difference Δp_{min} was determined with 50 Pa. The intermediate pressure stages were selected in accordance with the standard guidelines in a logarithmic series so that a total of 9 pressure stages were measured. The zero measurement was performed in the same way as 3.4.1.

4 TEST RESULTS

Note: the results and measured data shown in the test results and in enclosures 2 and 3 are based on measured data with a measuring accuracy of 0.02 m³/h.

Test condition A:

4.2 RESULTS according to EN 12207

TABLE A1: stress class achieved

Section	Test criteria	**Classification**
3.4.1	Air permeability (up to 600 Pa)	**4***
	*** Measurement results: no air permeability (impermeable)**	

4.3 RESULTS according to EN 12214

TABLE A2: air volume flow

Section	Test criteria	
3.4.2	Air volume coefficient C [m³/s Pa^n)]	Test pressure difference range in Pa
	0.000	**50 – 500**

TABLE A3: leakage exponent

Section	Test criteria	
3.4.2	Leakage exponent n [–]	Test pressure difference range in Pa
	0.000	**50 – 500**

TABLE A4: Permeability surface area

Section	Test criteria	
3.4.2	Equivalent permeability surface area A_L [m²]	Test pressure difference range in Pa
	0.000	**50 – 500**

Test condition B:

4.2 RESULTS according to EN 12207

TABLE B1: stress class achieved

Section	Test criteria	**Classification**
3.4.1	Air permeability (up to 600 Pa)	**4***
	*** Measurement results: no air permeability (impermeable)**	

4.3 RESULTS according to EN 12214

TABLE B2: air volume flow

Section	Test criteria	
3.4.2	Air volume coefficient C [m³/s Pa^n)]	Test pressure difference range in Pa
	0.000	**50 – 500**

TABLE B3: leakage exponent

Section	Test criteria	
3.4.2	Leakage exponent n [–]	Test pressure difference range in Pa
	0.000	**50 – 500**

TABLE B4: Permeability surface area

Section	Test criteria	
3.4.2	Equivalent permeability surface area A_L [m²]	Test pressure difference range in Pa
	0.000	**50 – 500**

Test condition C:

4.2 RESULTS according to EN 12207

TABLE C1: stress class achieved

Section	Test criteria	**Classification**
3.4.1	Air permeability (up to 600 Pa)	**4***
	*** Measurement results: no air permeability (impermeable)**	

4.3 RESULTS according to EN 12214

TABLE C2: air volume flow

Section	Test criteria	
3.4.2	Air volume coefficient C [m³/s Pa^n)]	Test pressure difference range in Pa
	0.000	**50 – 500**

TABLE C3: leakage exponent

Section	Test criteria	
3.4.2	Leakage exponent n [–]	Test pressure difference range in Pa
	0.000	**50 – 500**

TABLE C4: permeability surface area

Section	Test criteria	
3.4.2	Equivalent permeability surface area A_L [m²]	Test pressure difference range in Pa
	0.000	**50 – 500**

Test condition D:

4.2 RESULTS according to EN 12207

TABLE D1: stress class achieved

Section	Test criteria	**Classification**
3.4.1	Air permeability (up to 600 Pa)	**4***
	*** Measurement results: no air permeability (impermeable)**	

4.3 RESULTS according to EN 12214

TABLE D2: air volume flow

Section	Test criteria	
3.4.2	Air volume coefficient C [m³/s Pa^n)]	Test pressure difference range in Pa
	0.000	**50 – 500**

TABLE D3: leakage exponent

Section	Test criteria	
3.4.2	Leakage exponent n [–]	Test pressure difference range in Pa
	0.000	**50 – 500**

TABLE D4: Permeability surface area

Section	Test criteria	
3.4.2	Equivalent permeability surface area A_L [m²]	Test pressure difference range in Pa
	0.000	**50 – 500**

5 TEST REPORT VALIDITY

The test report only applies to the test object and to the conditions under which the test was performed.

The determination of the performance in accordance with “Point 1 – Application” does not allow a general statement to be made about the further performance or quality-determining characteristics of the structure concerned.

The air permeability test was recorded on the test object in new condition, no aging tests or stress rupture test were performed.

The test report will no longer be considered valid if the norms, test requirements and other rules cited in the standard which are relevant for the test and evaluation are withdrawn or amended, and/or if adverse changes are made to the construction, processing or properties of the materials used.

We recommend that checks are carried out at the latest upon expiry of five years from the date of issue, to ensure that compliance with the test and evaluation specifications applicable at this time is still maintained.

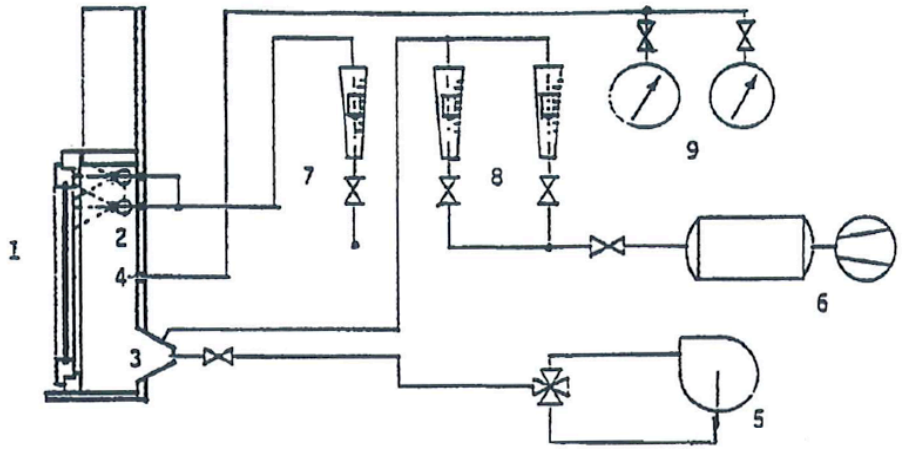
The test report may only be duplicated in full. Prior to duplicating an abbreviated form or extracts from the test report, written consent must be obtained from the laboratory for building physics at the Technical University of Graz’s Institute of Building Construction.

Graz, 10.06.2013

(Signature)		*(Signature)*
E. M. Reiterer Authorised signatory	*(Stamp of the Institute of Building Construction and Building Physics, Technical University of Graz)*	Dipl.-Ing. Heinz Ferk Laboratory Supervisor

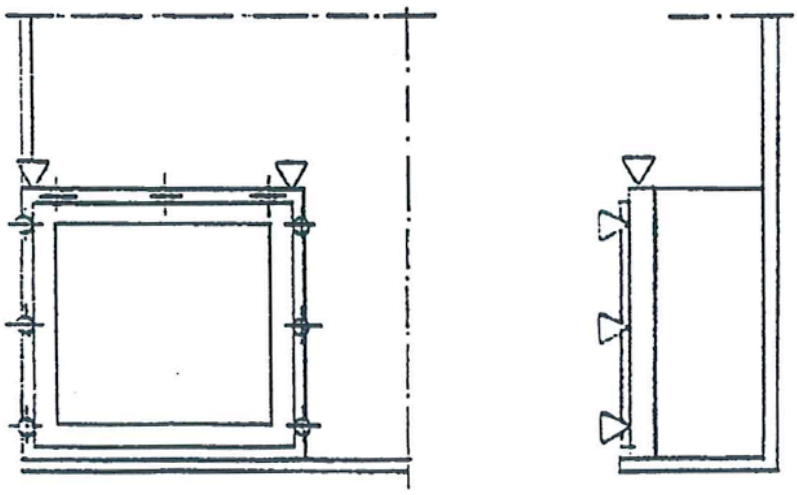
Accredited as a test and supervisory institute by the Austrian Institute of Construction Engineering (ÖIB) by certificate no. OIB-160-004/02-004
Issued as part of the scope of accreditation …… ☑

Enclosure 1



Explanation:

1. Test element
2. Spray nozzles
3. Air inlet
4. Pressure tapping point
5. Radial fan
6. Compressed air system
7. Floating cone measuring cylinders for water quantities
8. Floating cone measuring cylinders for air quantities
9. Membrane pressure sensor



Explanation:

⊕ Compressed air cylinder or threaded spindle, view from above
Δ Compressed air cylinder or threaded spindle, side view

<u>Diagram of attachment of test object to test bench</u>

Enclosure 2: Test record – Test condition A – Section 3.4.1

Table A1	Air permeability	
Test pressure difference	$V_{L,ref}$	V_{F1}
Pa	m³/(h.m)	m³/(h.m²)
50	0.00	0.00
100	0.00	0.00
125	0.00	0.00
200	0.00	0.00
250	0.00	0.00
300	0.00	0.00
450	0.00	0.00
600	0.00	0.00

$V_{L,ref}$ = length-based air permeability
V_{F1f} = total surface-based air permeability

IMPERMEABILITY TO DRIVING RAIN

Fig. 3.1: Location of water outlet

Air temperature in test bench	21.0 °C
Air temperature in test bench	21.0 °C

WIND RESISTANCE

Positive/negative pressure
Test pressure Pa

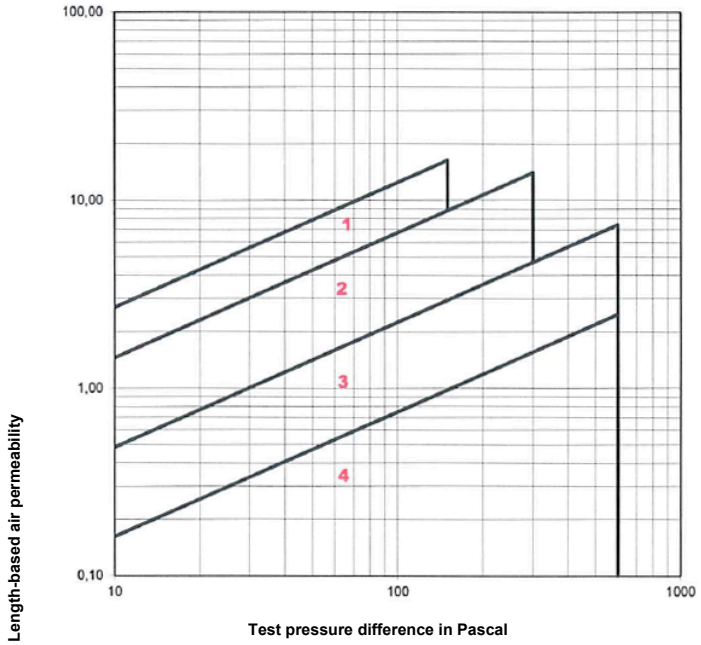
Damages:

With repeated pressure
Test pressure Pa

Damages:

Safety test
Test pressure Pa
Damages:

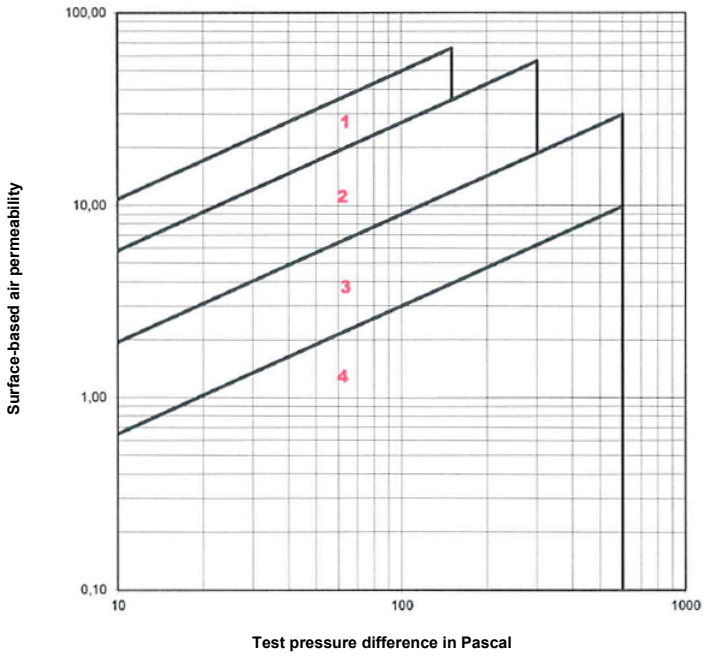
Diagram 3.1:
Length-based air permeability



Class 4 *

* no air permeability

Diagram 3.2:
Surface-based air permeability



Class 4

* no air permeability

Enclosure 4: Test record – Test condition B – Section 3.4.1

Table B1	Air permeability	
Test pressure difference	$V_{L,ref}$	V_{F1}
Pa	m³/(h.m)	m³/(h.m²)
50	0.00	0.00
100	0.00	0.00
125	0.00	0.00
200	0.00	0.00
250	0.00	0.00
300	0.00	0.00
450	0.00	0.00
600	0.00	0.00

$V_{L,ref}$ = length-based air permeability
V_{F1f} = total surface-based air permeability

IMPERMEABILITY TO DRIVING RAIN

Fig. 3.1: Location of water outlet

Air temperature in test bench 22.0 °C
Air temperature in test bench 22.0 °C

WIND RESISTANCE

Positive/negative pressure
Test pressure Pa

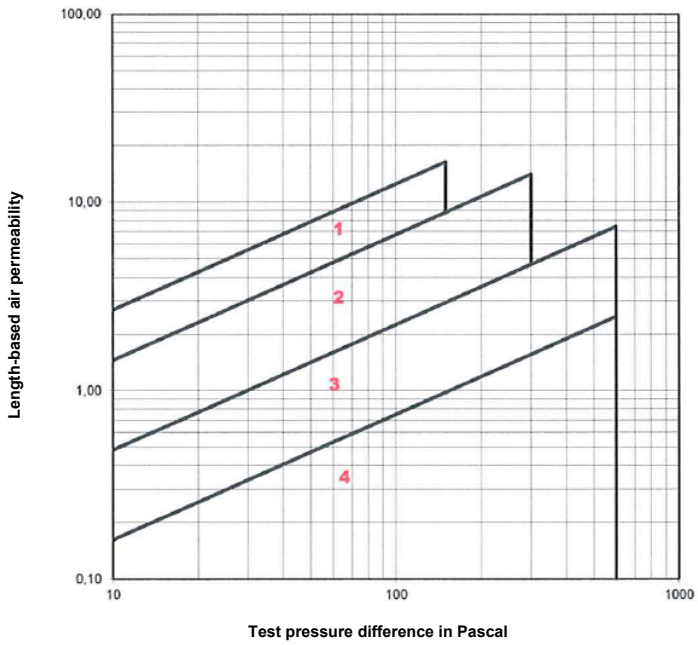
Damages:

With repeated pressure
Test pressure Pa

Damages:

Safety test
Test pressure Pa
Damages:

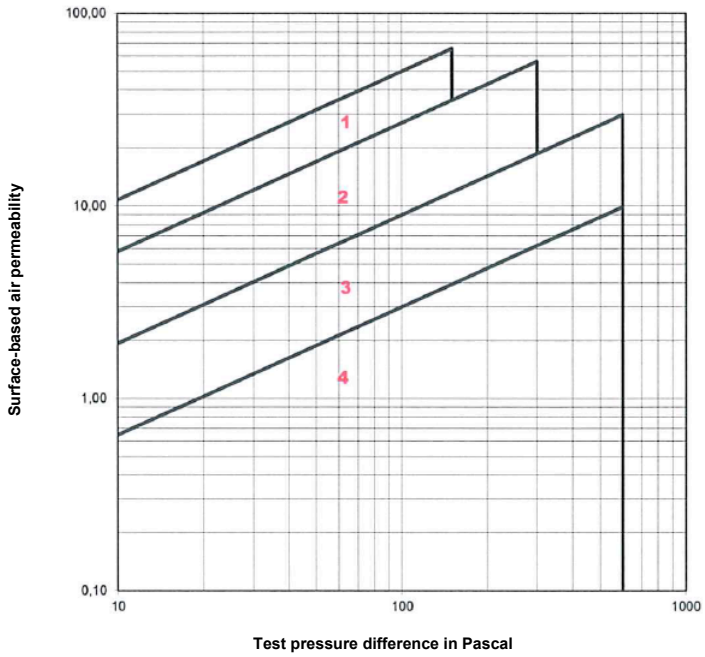
Diagram 3.1:
Length-based air permeability



Class 4

* no air permeability

Diagram 3.2:
Surface-based air permeability



Class 4

* no air permeability

Enclosure 4: Test record – Test condition C – Section 3.4.1

Table C1	Air permeability	
Test pressure difference	$V_{L,ref}$	V_{F1}
Pa	m³/(h.m)	m³/(h.m²)
50	0.00	0.00
100	0.00	0.00
125	0.00	0.00
200	0.00	0.00
250	0.00	0.00
300	0.00	0.00
450	0.00	0.00
600	0.00	0.00

$V_{L,ref}$ = length-based air permeability
V_{F1f} = total surface-based air permeability

IMPERMEABILITY TO DRIVING RAIN

Fig. 3.1: Location of water outlet

Air temperature in test bench	22.0 °C
Air temperature in test bench	22.0 °C

WIND RESISTANCE

Positive/negative pressure
Test pressure Pa

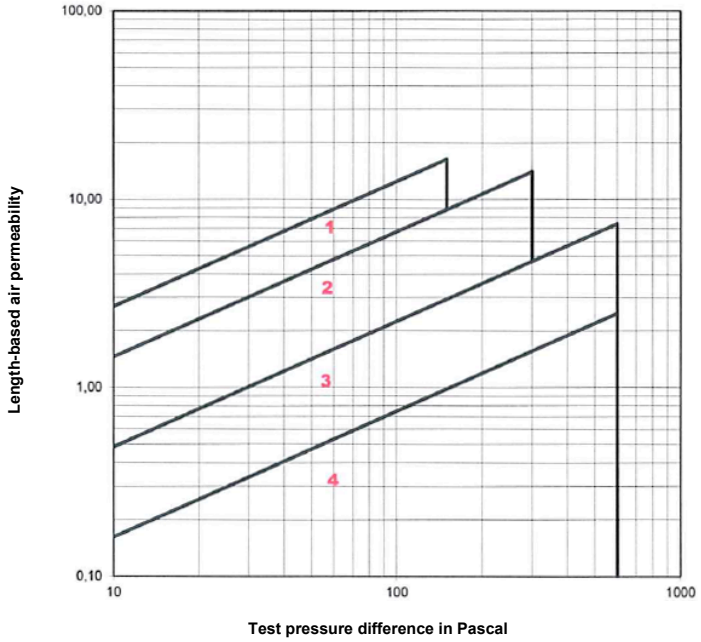
Damages:

With repeated pressure
Test pressure Pa

Damages:

Safety test
Test pressure Pa
Damages:

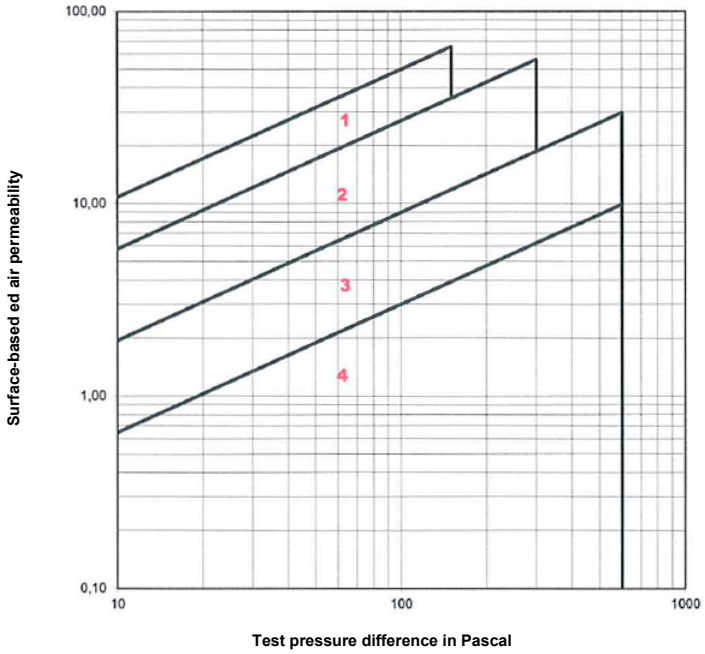
Diagram 3.1:
Length-based air permeability



Class 4

* no air permeability

Diagram 3.2:
Surface-based air permeability



Class 4

* no air permeability

Enclosure 2: Test record – Test condition D – Section 3.4.1

Table D1	Air permeability	
Test pressure difference	$V_{L,ref}$	V_{F1}
Pa	m³/(h.m)	m³/(h.m²)
50	0.00	0.00
100	0.00	0.00
125	0.00	0.00
200	0.00	0.00
250	0.00	0.00
300	0.00	0.00
450	0.00	0.00
600	0.00	0.00

$V_{L,ref}$ = length-based air permeability
V_{F1f} = total surface-based air permeability

IMPERMEABILITY TO DRIVING RAIN

Fig. 3.1: Location of water outlet

Air temperature in test bench	22.0 °C
Air temperature in test bench	22.0°C

WIND RESISTANCE

Positive/negative pressure
Test pressure Pa

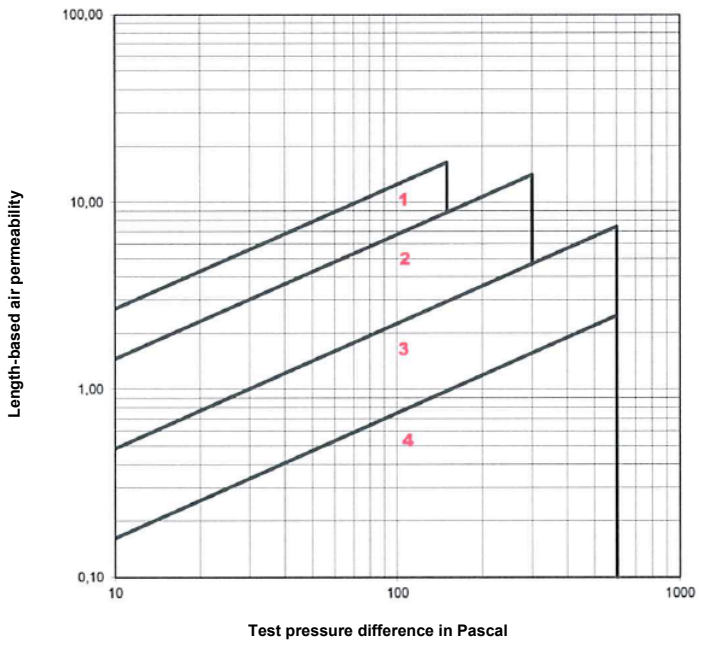
Damages:

With repeated pressure
Test pressure Pa

Damages:

Safety test
Test pressure Pa
Damages:

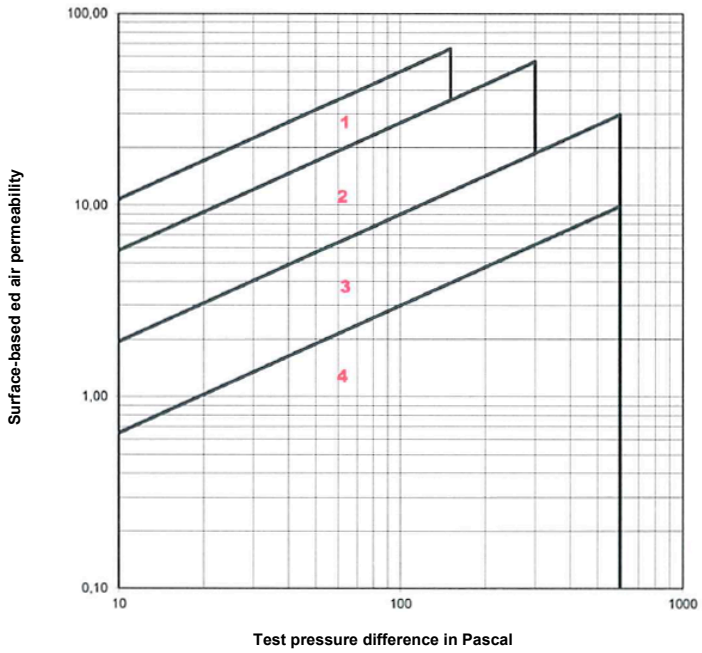
Diagram 3.1:
Length-based air permeability



Class 4

* no air permeability

Diagram 3.2:
Surface-based air permeability



Class 4

* no air permeability

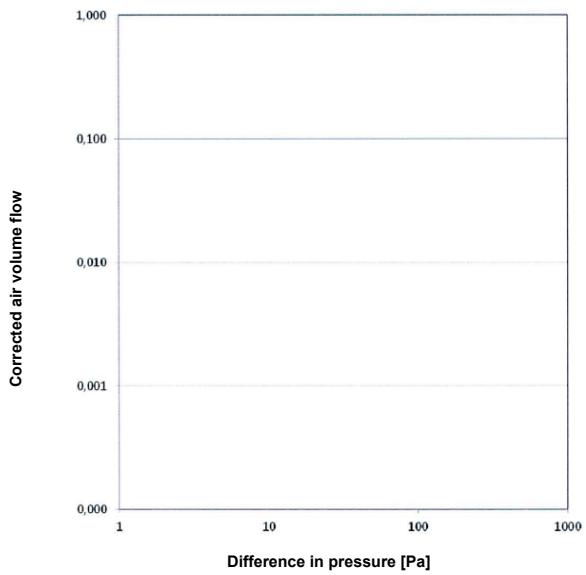
Enclosure 3: Test record – Test condition A – Section 3.4.2

Table A2-A4

Air permeability of components – Record

Description of test conditions:

Air temperature:	21.0 °C
Humidity:	30%
Air pressure:	96356 Pa
Lowest difference in pressure:	50
Highest difference in pressure:	500
Test date:	07.02.2013



Measurement results:

Difference in pressure Δp [Pa]	Overpressure: Residual volume flow [m³/s]	Overpressure: Air volume flow V [m³/s]	Overpressure: Corrected air volume flow V_0 [m³/s]	Underpressure: Residual volume flow [m³/s]	Underpressure: Air volume flow V [m³/s]	Underpressure: Corrected air volume flow V_0 [m³/s]
50	0.200	0.210	0.000			
67	0.660	0.660	0.000			
89	0.810	0.810	0.000			
119	1.040	1.040	0.000			
158	1.270	1.270	0.000			
211	1.600	1.600	0.000			
281	2.030	2.030	0.000			
375	2.680	2.690	0.000			
500	3.470	3.490	0.000			
Air volume flow coefficient C [m³/(s Pa^n)]	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –
Leakage exponent n [–]	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –
Equivalent permeability surface area A_L for an Δp of 10 Pa	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –

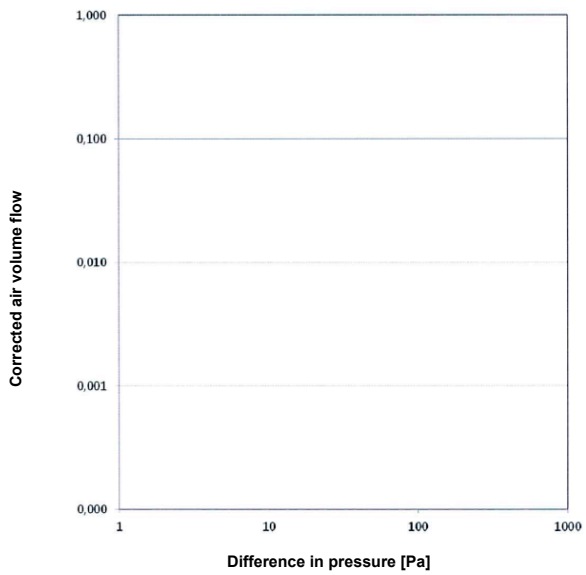
Enclosure 3: Test record – Test condition B – Section 3.4.2

Table B2-B4

Air permeability of components – Record

Description of test conditions:

Air temperature:	22.0 °C
Humidity:	29%
Air pressure:	97675 Pa
Lowest difference in pressure:	50
Highest difference in pressure:	500
Test date:	17.02.2013



Measurement results:

Difference in pressure Δp [Pa]	Overpressure: Residual volume flow [m³/s]	Overpressure: Air volume flow V [m³/s]	Overpressure: Corrected air volume flow V_0 [m³/s]	Underpressure: Residual volume flow [m³/s]	Underpressure: Air volume flow V [m³/s]	Underpressure: Corrected air volume flow V_0 [m³/s]
50	0.660	0.660	0.000			
67	0.710	0.710	0.000			
89	0.890	0.890	0.000			
119	1.060	1.060	0.000			
158	1.290	1.290	0.000			
211	1.600	1.600	0.000			
281	1.900	1.900	0.000			
375	2.300	2.300	0.000			
500	2.710	2.710	0.000			
Air volume flow coefficient C [m³/(s Pa^n)]	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –
Leakage exponent n [–]	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –
Equivalent permeability surface area A_L for an Δp of 10 Pa	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –

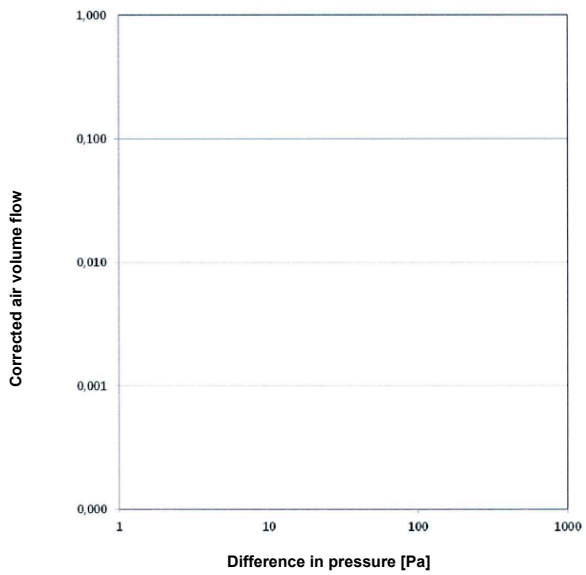
Enclosure 3: Test record – Test condition C – Section 3.4.2

Table C2-C4

Air permeability of components – Record

Description of test conditions:

Air temperature:	22.0°C
Humidity:	40%
Air pressure:	98280 Pa
Lowest difference in pressure:	50
Highest difference in pressure:	500
Test date:	25.04.2013



Measurement results:

Difference in pressure Δp [Pa]	Overpressure: Residual volume flow [m³/s]	Overpressure: Air volume flow V [m³/s]	Overpressure: Corrected air volume flow V_0 [m³/s]	Underpressure: Residual volume flow [m³/s]	Underpressure: Air volume flow V [m³/s]	Underpressure: Corrected air volume flow V_0 [m³/s]
50	0.130	0.130	0.000			
67	0.560	0.580	0.000			
89	0.660	0.680	0.000			
119	0.840	0.840	0.000			
158	1.080	1.090	0.000			
211	1.320	1.340	0.000			
281	1.670	1.670	0.000			
375	2.100	2.100	0.000			
500	2.530	2.560	0.000			
Air volume flow coefficient C [m³/(s Pa^n)]	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –
Leakage exponent n [–]	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –
Equivalent permeability surface area A_L for an Δp of 10 Pa	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –

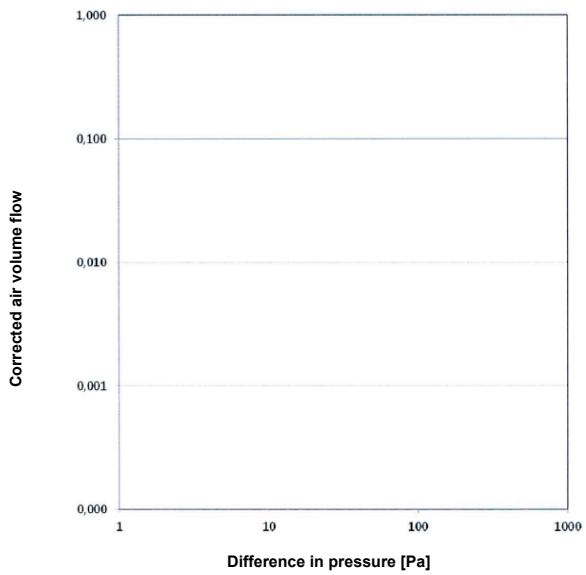
Enclosure 3: Test record – Test condition D – Section 3.4.2

Table D2-D4

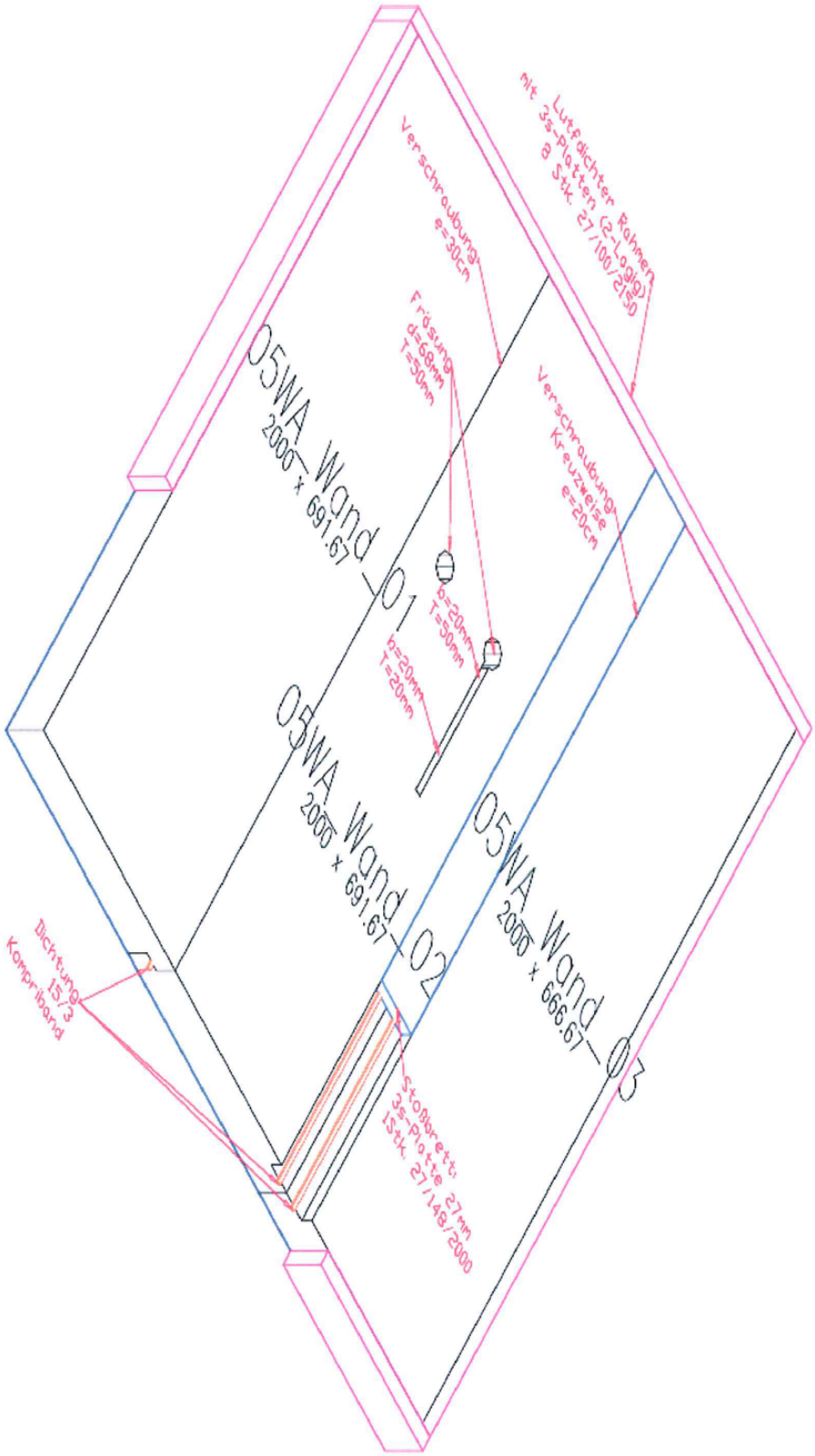
Air permeability of components – Record

Description of test conditions:

Air temperature:	22.0°C
Humidity:	51%
Air pressure:	96340 Pa
Lowest difference in pressure:	50
Highest difference in pressure:	500
Test date:	17.05.2013



Measurement results:

Difference in pressure Δp [Pa]	Overpressure: Residual volume flow [m³/s]	Overpressure: Air volume flow V [m³/s]	Overpressure: Corrected air volume flow V_0 [m³/s]	Underpressure: Residual volume flow [m³/s]	Underpressure: Air volume flow V [m³/s]	Underpressure: Corrected air volume flow V_0 [m³/s]
50	0.130	0.130	0.000			
67	0.150	0.150	0.000			
89	0.580	0.580	0.000			
119	0.680	0.680	0.000			
158	0.810	0.810	0.000			
211	1.060	1.060	0.000			
281	1.270	1.270	0.000			
375	1.570	1.600	0.000			
500	1.970	1.970	0.000			
Air volume flow coefficient C [m³/(s Pa^n)]	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –
Leakage exponent n [–]	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –
Equivalent permeability surface area A_L for an Δp of 10 Pa	**0.000**	95% confidence level:	– –	–	95% confidence level:	– –

Enclosure 3: Layout (provided by applicant)