Test Report:
Weathertightness test on an Alitherm 47 open inward door to BS ENs 1026, 1027 and 12211

Test report number 219 007c

BRE

Prepared for :
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1 Introduction

At the request of Mr. Mark Walford of Smart Systems Ltd, Yatton, North Somerset, BRE issued proposal number 113 311 on 22 July 2004. The proposal was accepted on 26 July 2004 and BRE tested a 2100 mm high x 952 mm wide Alitherm 47, open inward door on 24 August 2004.

The tests to methods in BS EN 1026[1], 1027[2] and 12211[3] measure the weathertightness of the specimen door in terms of air permeability, watertightness and resistance to wind load respectively. Classification of the results is based on BS EN 12207[5], 12208[6], 12210[7] and BS 6375: Part 1: 2004[4].

In this case the maximum test pressures requested by the client for the door are 600 Pa (Pascals) for air permeability, 300 Pa for watertightness and 2000 Pa as the test pressure P1 in the resistance to wind load test.

The tests on the specimen door were carried out under the BRE Standard Terms and Conditions of Business as part of BRE project number CV 0177.

2 Details of tests carried out

The weathertightness test on the test specimen was carried out to the requirements of BS EN 1026, 1027 and 12211 for air permeability, watertightness and resistance to wind load.

Depending on the exposure category tested to BS 6375: Part 1: 2004 classifies the results for products in the UK and also specifies that the air permeability test is performed under both positive and negative test pressures. Reference is also made to BS ENs 12207, 12208 and 12210 that classify the results when testing to the methods below. Both classification documents classify the weathertightness performance of completely assembled doors and windows of any material after testing to the methods below.

The weathertightness test comprised of three parts in the sequence:

1. Air permeability to BS EN 1026: 2000; by application of a series of test air pressure differentials across the specimen door with measurement of the air permeability of it at each pressure step. The maximum positive and negative pressure differential was 600 Pa reached in pressure steps of 50, 100, 150, 200, 250, 300, 450, and 600 Pascals.

2. Watertightness to BS EN 1027: 2000; by applying specified amounts of water spray to the outside face of the specimen door while incrementally increasing the air pressure differentials across it. The test pressure, time and position of any water penetration are recorded. The maximum positive air pressure differential was 300Pa. Pressure (Pa)/time (min) steps were 0/15, 50/5, 100/5, 150/5, 200/5, 250/5 and 300/5.

3. Resistance to wind load to BS EN 12211: 2000; by application of a series of positive and negative test air pressures. Measurements and inspections are made to assess relative frontal deflection and resistance to damage from wind loads.

   The resistance to wind load test includes a deflection test, a repeated pressure test and operational test, an air permeability test and finally a safety test. For the purpose of the resistance to wind load test three test pressures are defined:

   P1 applied to measure the deflections of parts of the test specimen.
   P2 50 cycles of pulsating pressure to assess performance under repeated wind loads.
   P3 applied to assess the safety of the test specimen under extreme conditions.

   The values of P1, P2 and P3 are related as follows: P2 = 0.5P1, P3 = 1.5P1.
   For these tests the values are: P1 = 2000 Pa, P2 = 1000 Pa and P3 = 3000 Pa.

   Note: The repeat air permeability test is an integral part of the resistance to wind load test and its significance is as an indicator of damage that may occur during that test.

3 Classification of results

According to BS 6375: Part 1: 2004 for a door to be included in an exposure category the test pressures for air permeability, watertightness and resistance to wind shall be attained or exceeded. It also states in clause 4 that doors that are tested and classified with a wind load greater than 1200 Pa shall be classified in accordance with BS EN 12207, 12208 and 12210. Details of those classifications are given below. The classifications given in BS 6375 are those suitable for the UK selected from the forgoing standards.

In this case the door was tested with a design wind load or P1 of 2000 Pa in mind and is therefore classified according to the following:

Air permeability — BS EN 12207: 1999. The classification is based on a comparison of the air permeability of the test specimen related to both overall area and length of opening joint. There are four classes; class 4 is applicable to the most airtight specimens while class 1 describes those with most air leakage. To meet any class the measured air permeability of the specimen must not exceed the upper limit at any test pressure step in that class.

Watertightness — BS EN 12208: 2000. The classification is based on a comparison of the watertightness of the test specimen related to test pressures and duration of the test. There are nine classes; 1A/1B up to 9A for test pressures from 0 Pa to 600 Pa. For specimens that remain watertight over 600 Pa for 5 minutes a class Exxx is used. The xxx is the maximum test pressure e.g. 750 Pa. To meet any class the specimen must remain watertight up to and for 5 minutes at the test pressure set for that class.

Resistance to wind load — BS EN 12210: 1999. The classification is based on a comparison of the resistance to wind loads of the test specimen when subjected to test pressures P1, P2 and P3. There are five classes; 1 up to 5 for P1 test pressures from 400 Pa to 2000 Pa. For specimens that are tested to P1 pressures exceeding 2000 Pa a class Exxxx is used. The xxxx is the actual test pressure P1 used e.g. 2400 Pa. To achieve any class the resistance of the specimen to wind load must meet all the requirements for that class.

Note:
Neither BS 6375: Part 1: 2004 or BS EN 12207: 1999 give guidance on how to classify the performance of doors when the air permeability under positive and negative pressures are significantly different. BRE's interpretation is that separate classifications are given for the performances under positive and negative test pressures respectively. This is based on the fact that these type of doors will behave differently under positive or negative test pressures and so the classifications should reflect that difference.

4 Test specimen

Type: Aluminium framed, single leaf, glazed inward opening door; left hand hung viewed from indoors. Reference: Smart Systems Ltd, Alitherm 47 inward opening door. Cross sectional drawings of the door are shown in the annex to this report.

Glazing: The door leaf is glazed from the inside with an insulating glass unit with 6 mm thick clear toughened glass and a 12 mm air gap. The glazing is retained by aluminium snap in glazing beads.

Seals: A compression type tubular seal fits into grooves on the door frame near the outdoor edge of the frame. This seal is bonded and sealed at the corners of the frame. Towards the indoor edge of the door frame is a second seal also housed in a groove. This seal is a brush type, with breaks where the locking mechanisms protrude from the door leaf. The corners are butted on the brush seal.

The glazing seals are preformed gaskets carried in a groove in the frame outdoors and on the glazing beads indoors. The corners are mitred and sealed.

Hardware: The door handle operates a latch and two locking points. A key operates the third central locking point. The locking points are at 280 mm and 270 mm in from the top and bottom corners of the leaf respectively and at 955 mm up from the bottom of the leaf. There are three butt hinges at 160 mm and 170 mm centres from the top and bottom of the leaf respectively and one at 1010 mm up from the bottom of the leaf.

Fixings: For these tests the door is fixed with wood screws into a 45 mm by 70 mm softwood surround frame.

Detail: The glazing beads are mitred at the corners. There are drainage points shielded by weather hoods below the glazing in the bottom rail of the door leaf. The threshold area also has drainage points again shielded by hoods on the outdoor face of the door frame.

Dimensions: 2100 mm high x 952 mm wide (overall). Area: 1.99 m²
Length of opening joint = 5.77 m
Span of frame member where deflections were measured = 2019 mm

5 Test rig and preparatory procedures

The test specimen was conditioned for at least 4 hours within temperature and humidity ranges specified in the test standards of 10°C to 30°C and 25% to 75% RH respectively.

The water temperature in the watertightness test was within the specified range of 4°C to 30°C.

The door was mounted in the BRE test rig 'G', to form one wall of a pressure box, with the outdoor face of the door enclosed in the box.

A single spray bar with three full circular cone nozzles was mounted in the pressure box to apply water to the outside face of the specimen at the rate of 2 L/min per nozzle in accordance with BS EN 1027 spraying method 1A.

Transducers were mounted on independent supports to measure deflections of a frame member retaining the insulating glass unit. Deflections were measured on the span at the positions indicated in Figure 1.

6 Summary of test results

The test results are summarised in Table 1 below. Figures show detail of the door and detailed results are given in Annex 1.

Tests	BS EN requirements		Test specimen performance	
	Max. test pressures Pa	Requirements	Test results	Classification
Air permeability	600	Max. air leakage rate at 600 Pa not to exceed: 9.91m³/h.m² in Cl.4 2.48m³/h.m in Cl.4 Under negative test pressures	At 600 Pa 12.03 m³/h.m² 4.17 m³/h.m 8.94 m³/h.m² 3.10 m³/h.m	 Class 3 Class 3 Class 3 overall Class 4 Class 3 Class 4 overall
Watertightness	300	No leaks up to and at 300 Pa – Class 7A	First leak at 250 Pa	Class 5A
Resistance to ± wind loads	P1 = 2000 P2 = 1000 P3 = 3000	At P1 and P2: Deflection of frame member not to exceed 1/150 No visible failures. Remain functional. Increase in air perm' not greater than 20% of the max. permissible air perm' for the class attained in the 1st air perm' test At P3: No parts become detached and specimen remains closed	max. 1/1174 on a stile at -2000 Pa No failures Functions OK Insignificant change Intact and remained closed	Classification of relative frontal deflection: Class C Classification of wind load: Class 5 Overall Classification for resistance to wind load: Class C5

Note: overall air permeability classifications are based on a comparison of classes met for air leakages per m² and per metre of opening joint not a comparison between leakages measured under positive and negative test pressures

Table 1. Summary of weathertightness test results

7 Conclusions

When the specimen Alitherm 47 door was tested to the standards described herein it was found to be:

- Sufficiently airtight to attain Class 3 overall under positive air pressures (the second highest classification) and Class 4 overall under negative air pressures (the highest classification), for air permeability.
- More air tight, after 450 Pa test pressure, under negative test pressures compared to positive pressures. This was largely due to the direction of opening of the door in relation to the application of air pressure in the tests.
- Resistant to water penetration using method 1A to Class 5A at 200 Pa.
- Resistant to wind loads of ±2000 Pa causing deflections less than 1/300 of the span of a door leaf stile, resistant to repeated pressure cycles of ±1000 Pa and able to sustain the corresponding safety test pressure of ±3000 Pa. The overall classification for resistance to wind load is Class C5.
- According to BS 6375: Part 1: 2004 this door would be suitable for UK exposure categories of 1200 (Pa). When tested to a design wind load of 2000 (Pa) the performance of the test door exceeded Class 2 for air permeability and the watertightness requirements of 100 Pa, Class 3A in BS 6375 and met the requirement for resistance to wind load.

8 References

1. BS EN 1026: 2000. Windows and doors – Air permeability – Test method. British Standards Institution, London.
2. BS EN 1027: 2000. Windows and doors – Watertightness – Test method. British Standards Institution, London.
3. BS EN 12211: 2000. Windows and doors – Resistance to wind load – Test method. British Standards Institution, London.
4. BS EN 12207: 2000. Windows and doors – Air permeability - Classification. British Standards Institution, London.
5. BS EN 12208: 2000. Windows and doors – Watertightness - Classification. British Standards Institution, London.
6. BS EN 12210: 2000. Windows and doors – Resistance to wind load - Classification. British Standards Institution, London.
7. BS 6375: Part 1: 2004. Performance of windows and doors – Classification for weathertightness and guidance on selection and specification

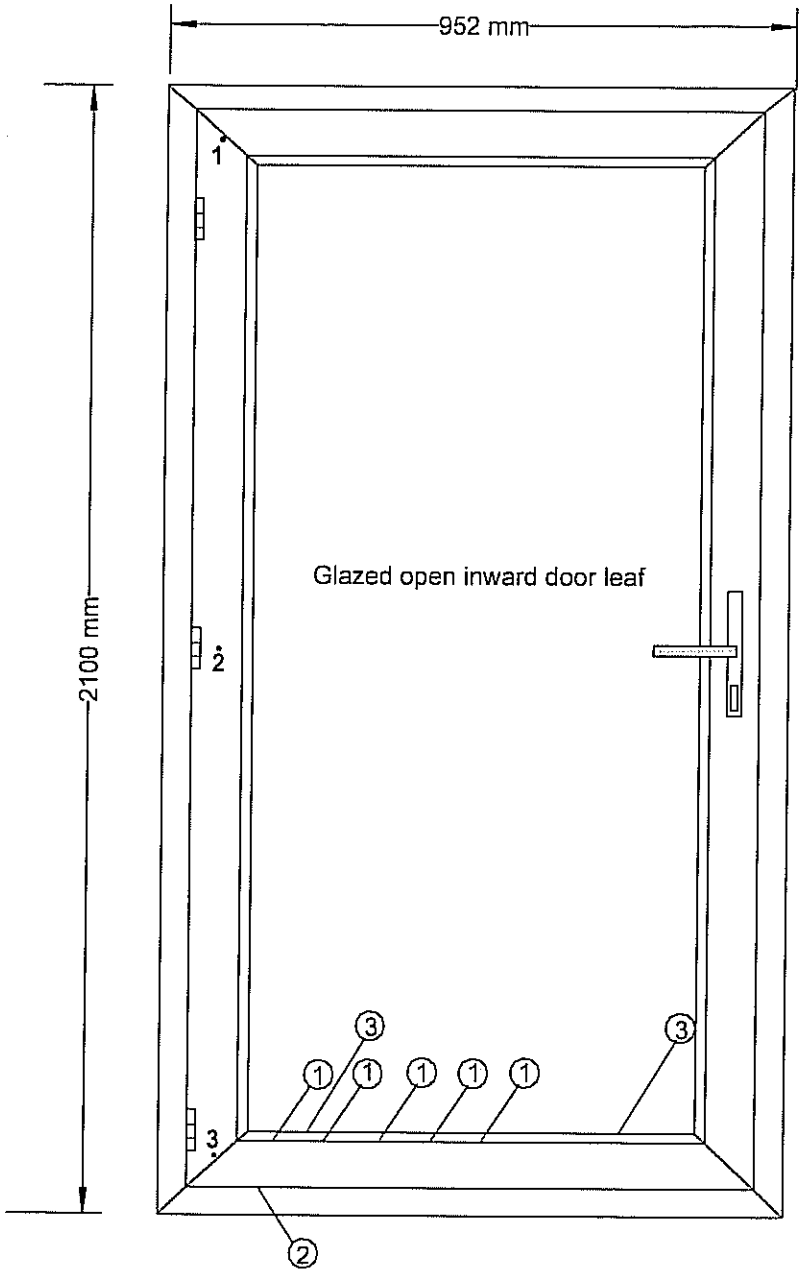
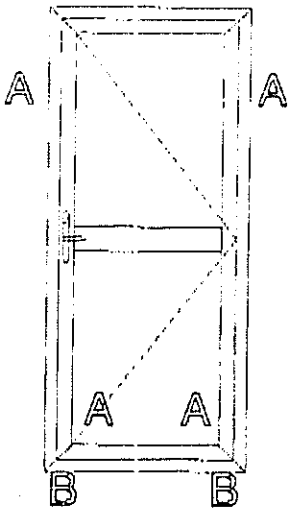


Figure 1. Outline sketch of the inside face of the door showing positions of deflection measurement points (on left hand stile) and points where water leaked through the door at 250 and 300 Pa test pressures

Weathertightness test on an Alitherm 47 open inward door to BS EN 1026, 1027 and 12211

A & B INDICATE DRAINAGE AND SASH VENTILATION

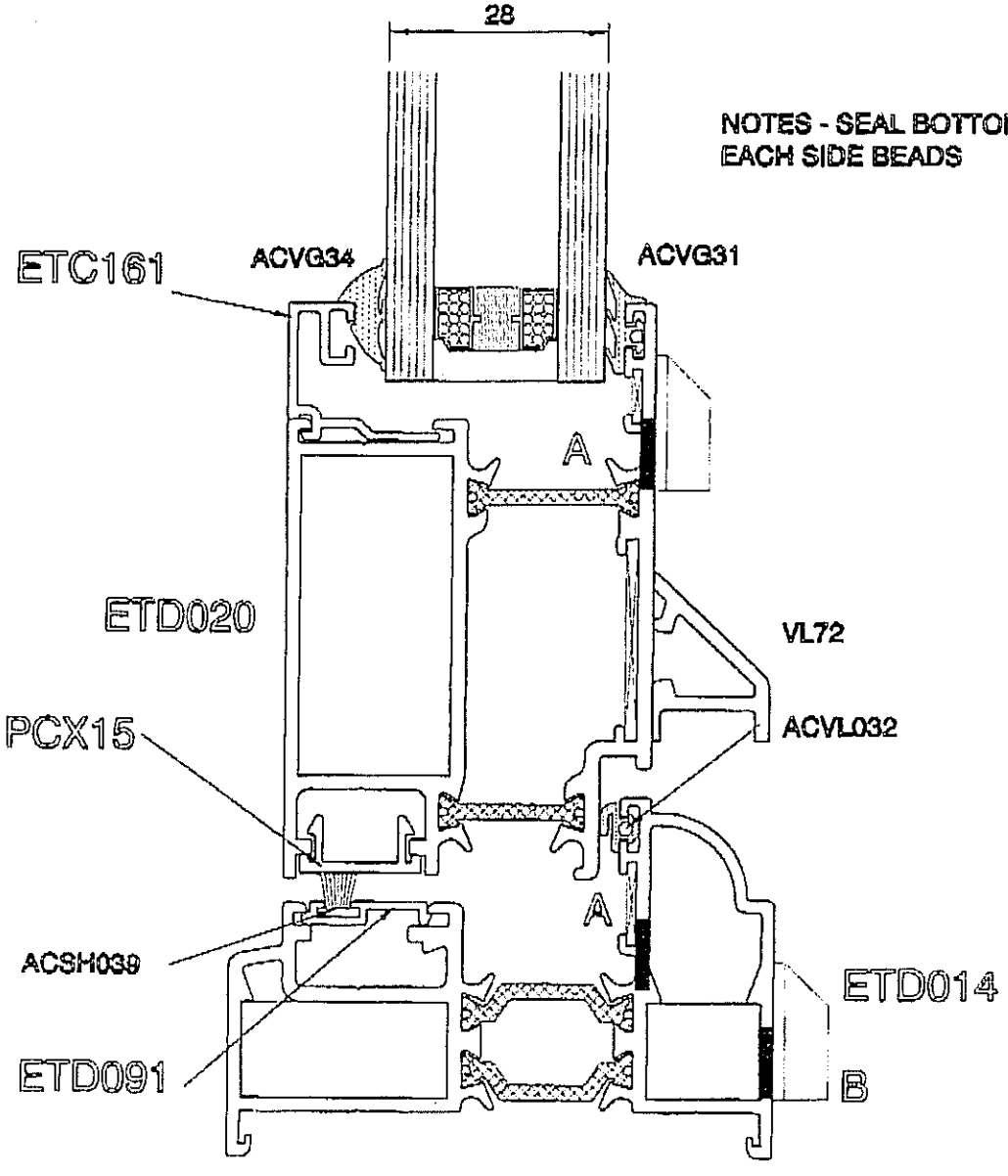


FINISH - RED P.P.C.

CONSTRUCTION - MECHANICAL CLEATS GLUED AND SEALED

HARDWARE
THREE POINT LOCK - ACET086
HINGES - ACET054
GLASS - 6/12/6 TOUGHENED SEALED UNITS
FIXING - SCREWED INTO TIMBER SUB FRAME FOR TEST PURPOSES

NOTES - SEAL BOTTOM BEADS AND 100mm UP EACH SIDE BEADS



Drawing showing a cross section of frame members at the base of the door

ANNEX 1. Weathertightness test results

Air permeability test under positive air pressure

Pressure differential Pa	Air flow through the specimen m^3/h	Air flow per unit area of the specimen $m^3/h.m^2$	Air flow per metre of opening joint $m^3/h.m$
50	4.49	2.25	0.78
100	6.39	3.20	1.11
150	7.92	3.96	1.37
200	9.15	4.58	1.59
250	10.20	5.10	1.77
300	11.62	5.81	2.01
450	16.16	8.08	2.80
600	24.05	12.03	4.17

Table A1. Air permeability under positive air pressure; test results

Air permeability test under negative air pressure

Pressure differential Pa	Air flow through the specimen m^3/h	Air flow per unit area of the specimen $m^3/h.m^2$	Air flow per metre of opening joint $m^3/h.m$
50	4.62	2.31	0.80
100	6.81	3.41	1.18
150	8.50	4.29	1.49
200	9.92	4.96	1.72
250	11.35	5.68	1.97
300	12.37	6.19	2.14
450	15.48	7.74	2.68
600	17.87	8.94	3.10

Table A2. Air permeability under negative air pressure; test results

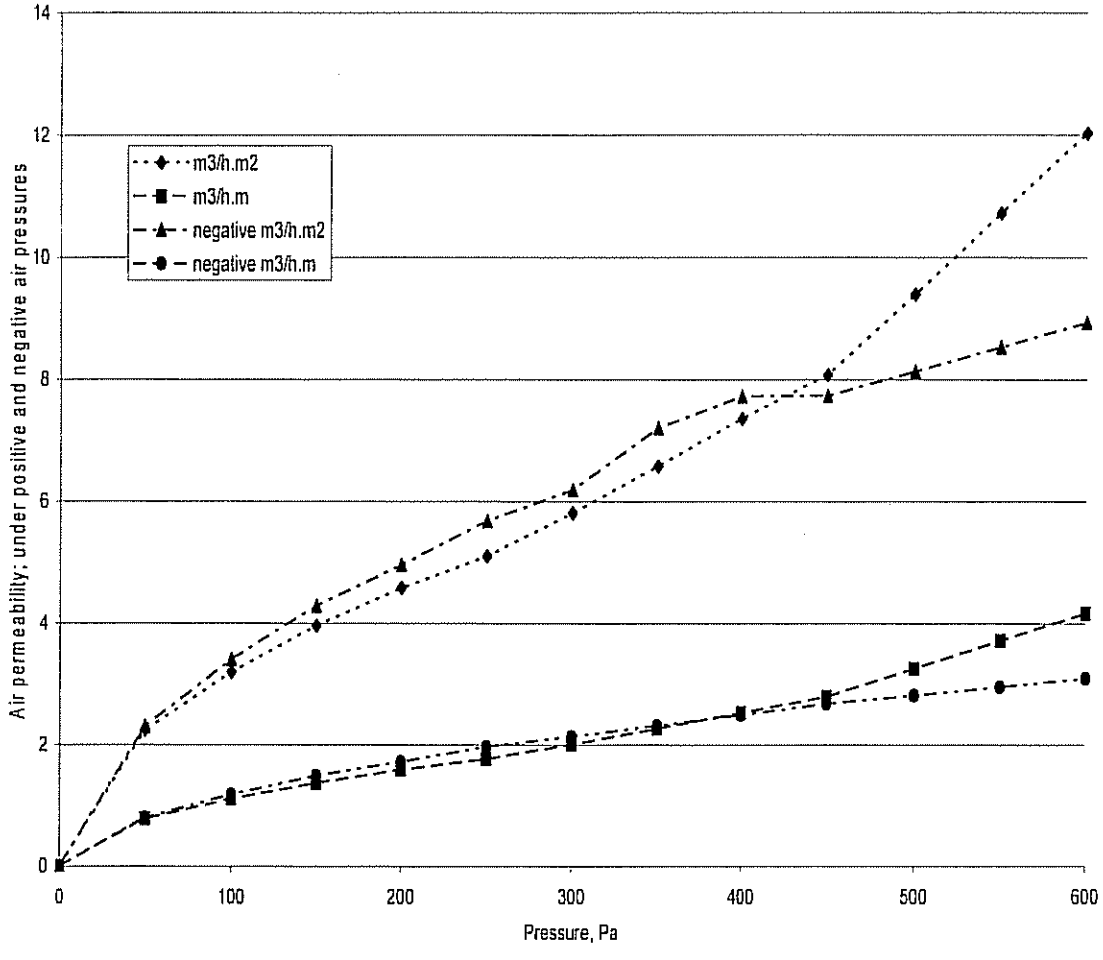


Figure A1. Air permeability under positive and negative air pressure; test results

Watertightness test

Pressure differential Pa	Duration Minutes	Water leaks
0	15	Nil
50	5	Nil
100	5	Nil
150	5	Nil
200	5	Nil
250	5	Leaked after 2.5 minutes at 250 Pa between the bottom glazing bead and the leaf frame simultaneously at five points along the bead.
300	5	Continued as at 250 Pa and leaked after 1.5 minutes at 300 Pa along the bottom opening joint. Also, leaked after 3.0 minutes at the glazing seal on the bottom rail of the leaf

Test laboratory conditions: Air temperature 20.3°C. Test chamber air temperature 20.2°C
Air pressure 1002 mb. Relative humidity 62.5% at 20.3°C

Table A3. Watertightness test results

Resistance to wind load – Deflection test

Position deflection measured	Positive pressure P1 to +2000 Pa		Negative pressure P1 to - 2000 Pa	
	Deflection		Deflection	
	mm	defl./span	mm	defl./span
Mid height of door leaf stile	1.34	1/1507	1.72	1/1174

Note: The deflection at the mid-point of a member is measured relative to its ends, e.g. with reference to Figure 1: Deflection at the mid-point = deflection at the mid-point – average of deflections at the two ends of the same member.

Table A4. Deflections measured on a door leaf stile in the resistance to wind load test at ± 2000 Pa.

Resistance to wind load – Repeated pressure test including the second air permeability test

Repeated pressure	Damage or functional defects
50 cycles to P2 at ±1000 Pa	None

Table A5. Damage or functional defects after repeated pressures to P2 at ±1000 Pa

Second air permeability test under positive air pressures (part of resistance to wind load test)

Pressure differential Pa	Air flow through the specimen m^3/h	Comparison to the air permeability measured previously (see Table A1)
50 100 150 200 250 300 450 600	4.24 5.86 7.12 8.77 8.72 9.83 13.26 17.19	After the test pressures P1 and P2 were applied the amounts of air flowing through the test specimen were not significantly different to those measured previously

Table A6. Second air permeability test results under positive air pressures

Second air permeability test under negative air pressures (part of resistance to wind load test)

Pressure differential Pa	Air flow through the specimen m^3/h	Comparison to the air permeability measured previously (see Table A2)
50 100 150 200 250 300 450 600	4.00 6.57 8.47 9.64 11.03 12.14 15.52 17.75	After the test pressures P1 and P2 were applied the amounts of air flowing through the test specimen were not significantly different to those measured previously

Table A7. Second air permeability test results under negative air pressures

Resistance to wind load - Safety test

Safety test	Condition after test
One pressure pulse to pressure: P3 at - 3000 Pa P3 at +3000 Pa	No parts became detached and the test door remained closed

Table A8. Condition of the door after the safety test to P3 at ±3000 Pa

==========REPORT ENDS==========