Weathertightness test to BS 6375: Part 1: 2004 on a Smart Systems Ltd Visoline open inward double door with lights to one side

Prepared for: Mr. M. Walford

Smart Systems Ltd

07 February 2007

Test report number 234 639

UKAS TESTING

0578

Tested on behalf of BRE by

Name	Malcolm Pound
Position	Laboratory Manager and Senior Consultant, Actions, Centre for Materials and Engineering
Date	06 February 2007
Signature	M.C. Pound

Prepared on behalf of BRE by

Name	Malcolm Pound
Position	Laboratory Manager and Senior Consultant, Actions, Centre for Materials and Engineering
Date	07 February 2007
Signature	M.C. Pound

Approved on behalf of BRE

Name	Dr. P. Blackmore
Position	Associate Director, Actions, Centre for Materials and Engineering
Date	15/2/07
Signature	P Blackmore

BRE
Garston
WD25 9XX
T + 44 (0) 1923 664000
F + 44 (0) 1923 664010
E enquiries@bre.co.uk
www.bre.co.uk

BRE is not UKAS accredited to make opinions and interpretation. Any opinions and interpretations included as part of this report are clearly marked as such.

UKAS TESTING
0578

1 Introduction

At the request of Mr. M. Walford of Smart Systems Ltd, Arnolds Way, Yatton, North Somerset, BS49 4UN, BRE issued proposal number 119241 on 11 January 2007. The proposal was accepted on 24 January 2007 and BRE tested the specimen on the 06 February 2007.

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

There are double doors, an opening window and a fixed light forming one test specimen replicating units to be installed at a development in Portsmouth. The final tests were carried out to the criteria in BS 6375: Part 1: 2004 for UK exposure category '1600'. Part of the resistance to wind load test was started with a P1 test pressure of 2000 Pa; then 1600 Pa was used finally.

The tests on the specimen were carried out under the BRE Standard Terms and Conditions of Business and to the UKAS BRE Specific Procedures Series F, as BRE Job number 234639 in project number CV1620.

2 Details of tests carried out

The weathertightness test on the test specimen was carried out to the requirements of BS 6375: Part 1: 2004, BS EN's 1026, 1027 and 12211 for air permeability, watertightness and resistance to wind load.

BS 6375: Part 1: 2004 specifies that the air permeability test is performed under both positive and negative test pressures, water tightness test method A is used and that deflections measured during the resistance to wind test do not exceed 1/150 of the span. 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 with measurement of the air permeability of it at each pressure step. The maximum planned positive and negative pressure differential was 600 Pa reached in pressure steps of 50, 100, 150, 200, 250, 300, 450 and 600 Pa.

2. Watertightness to BS EN 1027: 2000; by applying specified amounts of water spray to the outside face of the specimen while incrementally increasing the air pressure differential across it. The test pressure, time and position of any water penetration are recorded. The maximum positive air pressure differential was 600 Pa. Pressure (Pa)/time (min) steps were 0/15, 50/5, 100/5, 150/5, 200/5, 250/5, 300/5, 450/5 and 600/5 Pascals.

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 initial test values specified by the client were: P1 = 2000 Pa, P2 = 1000 Pa and P3 = 3000 Pa. The deflection test was started using these test values. However, subsequent to the first of three preparatory pressure pulses at 2200 Pa being performed and further discussions with the client the test values were changed. The values under which the full resistance to wind load test was performed were P1 = 1600, P2 = 800 Pa and P3 = 1760 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

The classifications from BS 6375: Part 1: 2004 for a UK exposure category of 1600 has air permeability at Class 2/300 Pa, watertightness at Class 5A/200 Pa and resistance to wind load at Class 4, P1 1600 Pa, P2 800 Pa and P3 2400 Pa. BS ENs 12207, 12208 and 12210 also classify the weathertightness performance of completely assembled windows and doors of any material after testing to the methods referred to earlier.

The relevant product standard BS EN 14351-1:2006[8] also states that classification of air permeability is based on the averages of the positive and negative air leakage values at each pressure step.

The BS EN classifications are explained below:

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 for 5 minutes up to and 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: Currently, neither BS 6375: Part 1: 2004 or BS EN 12207: 1999 give guidance on how to classify the performance of windows and doors considering the averages of air permeability under positive and negative test pressures. The product standard BS EN 14351-1 2006 does in Clause 4.14. This report has results for air permeability under positive and negative test pressures and displays on a graph the average air permeability for them at each pressure step.

4 Test specimen

The general details about the test specimen supplied by Smart Systems Ltd for these tests are given below:

Type: Aluminium frame members with; Inward opening double doors consisting of an active and a passive leaf, a tilt and turn inward opening window and one fixed light. Reference: Smart Systems Ltd, Visoline double door with light to one side 2325 mm high x 2780 mm wide. window. Drawings in the Annex of this report show cross sections of the frame members.

Glazing: All of the door leafs and lights are glazed from the indoor face with insulating glass units with 6 mm thick toughened glass and a 16 mm air gap. Aluminium beads retain the glazing seals and the glazing.

Seals: **Door;** The active door leaf has a fin type seal, continuous at the corners and with a single butt joint along the top edge of the leaf. The passive door leaf has a fin type seal at the hinge, top and bottom edges. The meeting stile on the passive leaf carries a fin type seal (larger section than those on the leafs). The door frame has a fin type seal (larger section than those on the leafs) all around the opening. The glazing seals are Neoprene with mitred, bonded corners
Window; The sash carries a fin type seal, continuous at the corners and with a single butt joint along the top edge of the sash. The window frame has a fin type seal ((larger section than those on the sash). The glazing seals are Neoprene with mitred, bonded corners.
Sealant; Sealant is applied to the glazing beads along the bottom rails and up to about 150 mm up each stile. The transoms (below the lights) have sealant applied to the internal corners. Joints in the seals have sealant applied to them.

Hardware: **Door;** Each leaf is hung on four hinges. On the active leaf there is a single lockable handle (midway up the meeting stile) that operates four Fapim espagnolette locking bolts. The keeps for these are on the passive leaf. The passive leaf has shoot bolts top and bottom operated by a single lever on the locking edge of leaf.
Window; The window has one lockable handle midway up the lefthand stile that operates three Fapim espagnolette locking points along the same stile; one at the opposite edge and the tilt turn mode change mechanism.

Fixings: For these tests the specimen was fixed and sealed into a wood surround frame with screws along on all sides.

Detail: The bottom rail of the sash has two drainage holes and the transom below has two leading to the outdoor face. The bottom rail of the door leafs have two drain holes and the threshold area has a drainage channel (closer to the outdoor edge of the door frame) with holes leading through to a slot (full width of the specimen) on the outdoor face. Any water draining from the slot exits onto the flashing near the foot of the specimen.

Dimensions: 2325 mm high x 2780 mm wide (overall). Area: 6.46 m²
Length of opening joint = 16.87 m

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

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

Transducers were mounted on independent supports to measure deflections of a frame member on the window. 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 specimen and detailed results are given in Annex 1.

BS	Air permeability		Watertightness		Resistance to wind loads	
	Requirements	**Results**	**Requirement**	**Results**	**Requirements**	**Results**
BS 6375	Class 2 to 300 Pa	**Met the requirements** of Class 2 for the average of positive and negative tests	Class 5A at 200 Pa	Class 7A @ 300Pa **Met & exceeded the require–ments**	Class A4: P1 = 1600 Pa P2 = 800 Pa P3 = 2400 Pa	**Met all of the require-ments** for Class A4

Table 1. Summary of weathertightness test results

7 Conclusions

When the specimen Smart Systems Ltd, 2325 mm high x 2780 mm wide (overall) Visoline double door with side lights was tested to the standards described herein it was found to be:

- Sufficiently airtight to attain Class 2 for the average of the results from positive and negative test pressures thus **meeting** the BS 6375: Part 1: 2004 requirements for Class 2.
- Resistant to water penetration using method 2A to Class 7A at 300 Pa thus **meeting and exceeding** the BS 6375: Part 1: 2004 requirements for Class 5A at 200 Pa.
- Resistant to wind loads of ±1600 Pa causing deflections less than 1/150 of the span of the mullion. Resistant to repeated pressure cycles of ±800 Pa and able to sustain the corresponding safety test pressure of ±3000 Pa. The overall classification for resistance to wind load is Class A5. **Meets** the requirements of BS 6375: Part 1: 2004

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 6375: Part 1: 2004. Performance of Windows and doors – Classification for weathertightness and guidance on selection and specification
5. BS EN 12207: 2000. Windows and doors – Air permeability - Classification. British Standards Institution, London.
6. BS EN 12208: 2000. Windows and doors – Watertightness - Classification. British Standards Institution, London.
7. BS EN 12210: 2000. Windows and doors – Resistance to wind load - Classification. British Standards Institution, London.
8. BS EN 14351-1:2006 Windows and doors – Product standard. British Standards Institution, London

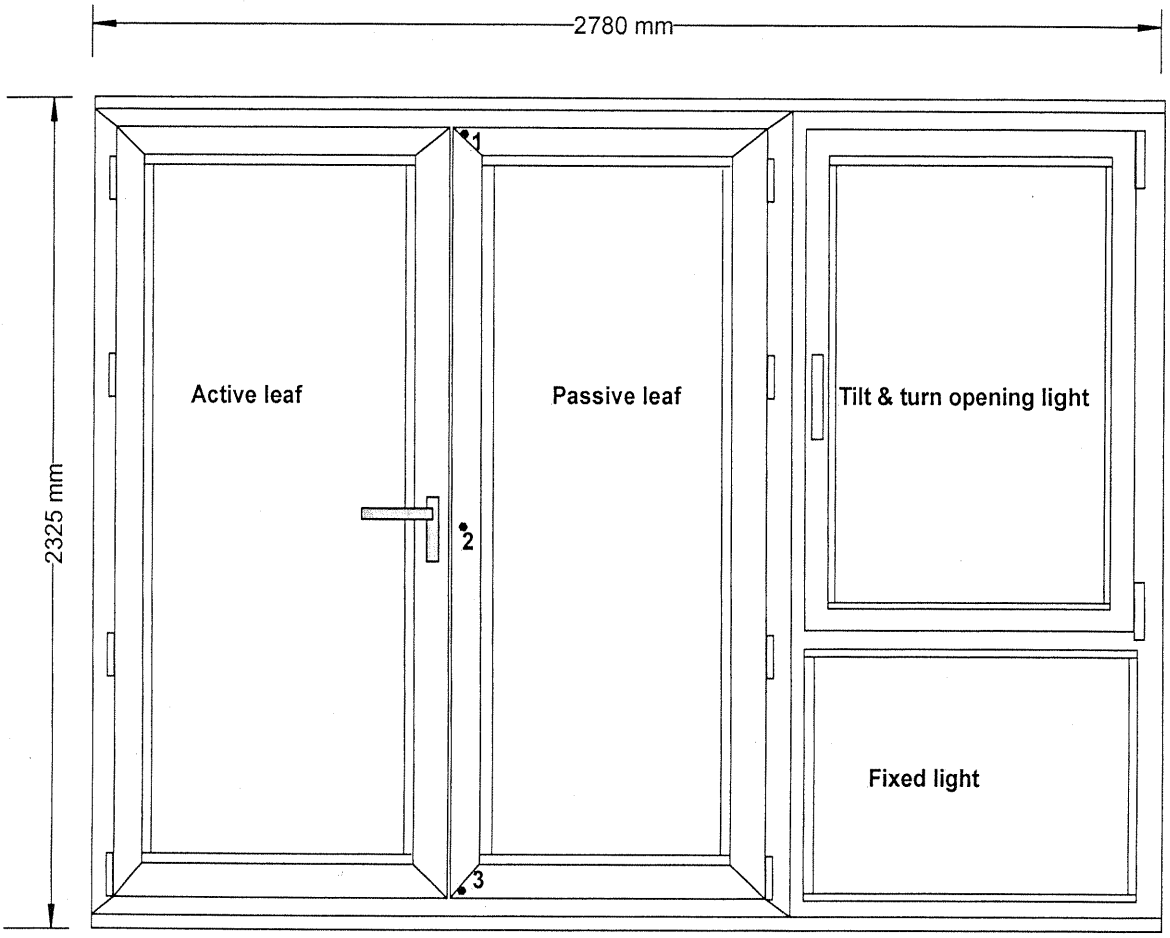


Figure 1. Outline sketch of the inside face of the specimen showing positions of deflection measurement points on a door leaf stile

ANNEX 1. Weathertightness test results

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	18.35	2.84	1.09
100	29.87	4.62	1.77
150	42.51	6.58	2.52
200	55.93	8.65	3.31
250	69.25	10.71	4.10
300	82.12	12.70	4.87
450	*		
600	*		

*Air flow rate increased to beyond the capacity of the measuring equipment indicating that under positive test pressures the specimen would not achieve Classes 3 or 4. Under the influence of positive test pressures compression of the seals in opening joints on the inward opening doors and window will reduce

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

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	8.89	1.38	0.53
100	9.09	1.41	0.54
150	10.29	1.59	0.61
200	8.98	1.39	0.53
250	8.73	1.35	0.52
300	8.72	1.35	0.52
450	10.76	1.66	0.64
600	12.25	1.90	0.73

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

Pressure differential Pa	Average air flow per unit area of the specimen $m^3/h.m^2$	Average air flow per metre of opening joint $m^3/h.m$
50	2.11	0.81
100	3.02	1.16
150	4.09	1.57
200	5.02	1.92
250	6.03	2.31
300	7.03	2.70
450	*	
600		

*see note above

Table A3. Averages of air permeabilities under positive and negative air pressures; test results

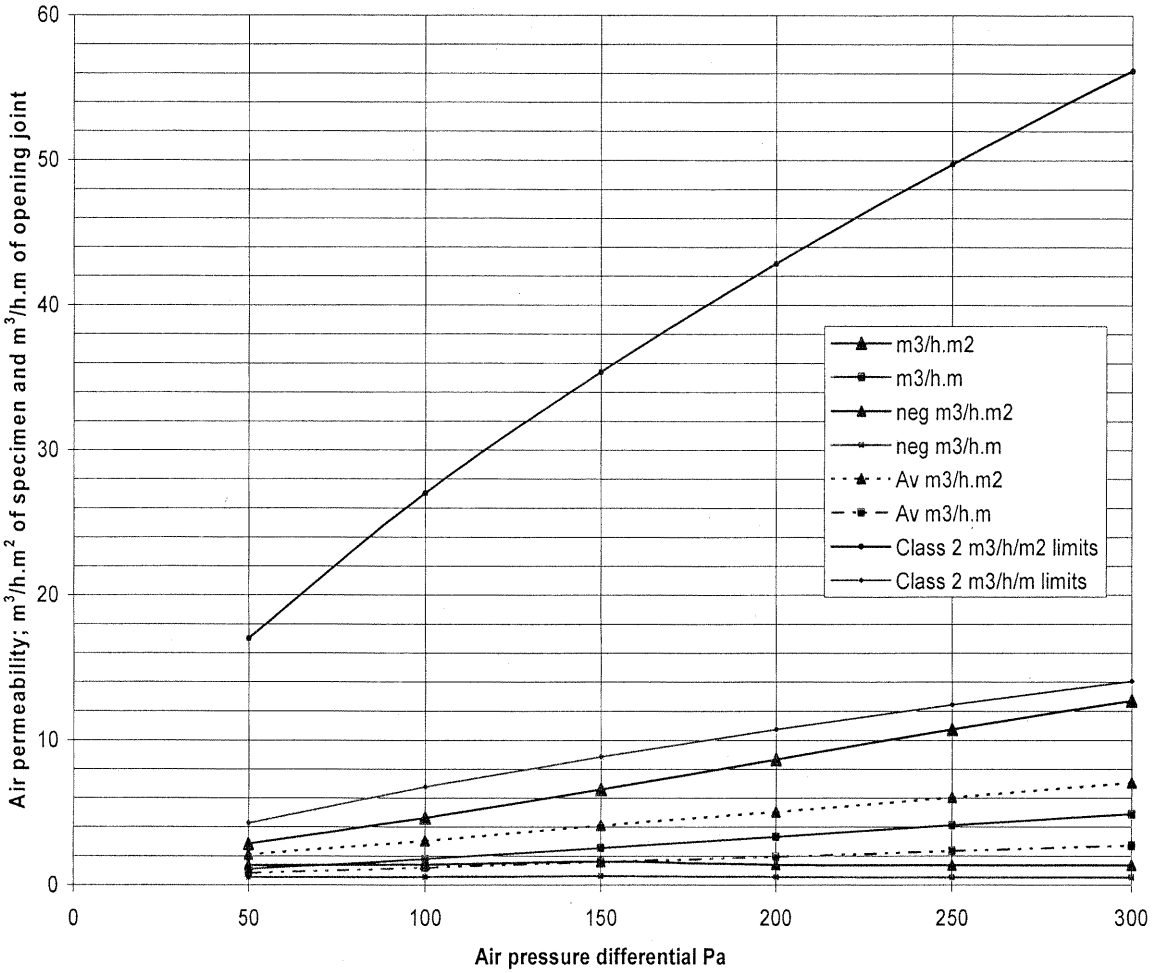


Figure A1. Test results: Air permeability under positive and negative air pressure; showing limits and averages of air permeabilities measured under positive and negative test pressures

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	Nil
300	5	Nil
450	5	1st leak at the bottom of the door's meeting stiles at opening joint, immediate on reaching 450 Pa. 2nd leak at the door's bottom right hand corner of the passive leaf at opening joint, immediate on reaching 450 Pa. 3rd leak at the bottom left hand corner of the active leaf opening joint after 2 mins at 450 Pa.
600	5	Leaks 1 to 3 continued and a 4th leak occurred at the hinges at the left hand side of the active leaf on the door after 2 mins at 600 Pa.

Test laboratory conditions: Air pressure 1000 mb. Relative humidity 33.6 % at 18°C
Air temperature18°C. Test chamber air temperature 20°C
Water temperature 18°C

Table A4. Water tightness test results

Resistance to wind load tests

Notes:
Some initial attempts were made to perform the preparatory gusts at 2200 Pa positive pressure. Maximum attained in these attempts was 1700 Pa. After progressively sealing the specimen's opening joints with adhesive tape a positive pressure preparatory pulse was performed to 2200 Pa. At that pressure the top shoot bolt keep fractured; the keep was repositioned to make use of the unbroken end of the same keep. After discussions with the client testing continued with a P1 test pressure of 1600 Pa, giving P2 of 800 Pa and P3 of 2400 Pa.

Resistance to wind load – Deflection test at ± 1600 Pa

Position deflection measured	Positive pressure P1 to +1600 Pa		Negative pressure P1 to - 1600 Pa	
	Deflection		Deflection	
	mm	defl./span	mm	defl./span
Mid height of the passive leaf meeting stile	10.22	1/214	9.73	1/225

Notes: 1) 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 A5. Deflections measured on a door leaf meeting stile in the resistance to wind load test at ± 1600 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 ± 800 Pa	The lowest espagnolette locking point on the door disengaged but the door remained closed. The specimen remained functional after the repeated pressure test. The locking point was adjusted and testing continued with the second air permeability tests.

Table A6. Damage or functional defects after repeated pressures to P2 at ±800 Pa

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

Pressure differential Pa	Air flow through the specimen m³/h	Comparison to the air permeability measured previously (see Table A1)
50 100 150 200 250 300 450 600	13.84 25.44 39.82 51.81 63.21 80.40 * 	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

* see note under Table A1

Table A7. 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 m³/h	Comparison to the air permeability measured previously (see Table A2)
50 100 150 200 250 300 450 600	7.73 10,15 11.50 12.19 9.63 10.31 11.73 13.00	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

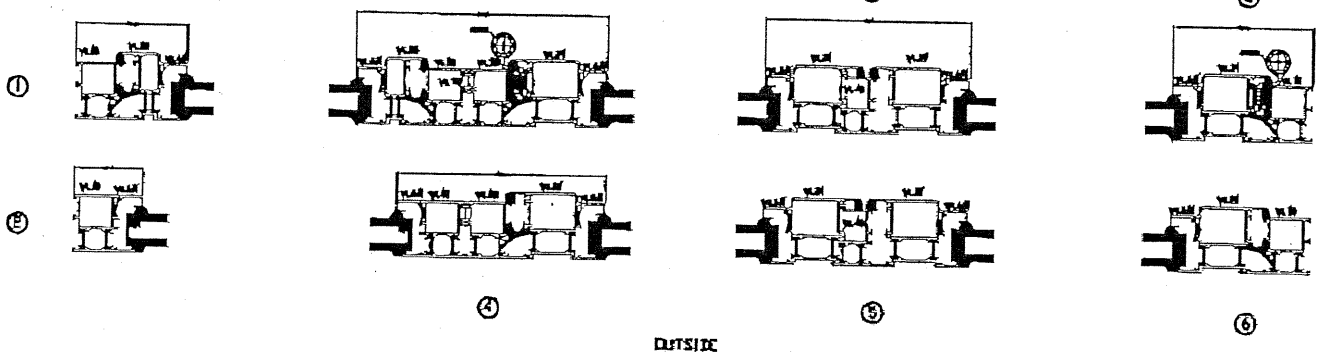
Table A8. Second air permeability test results under negative air pressures

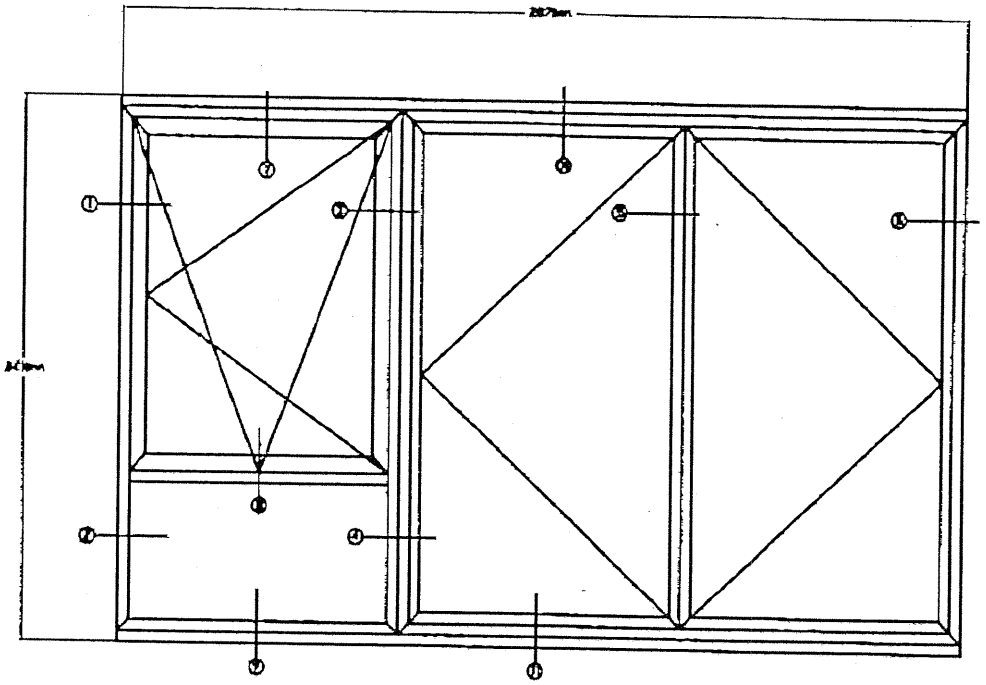
Resistance to wind load - Safety test

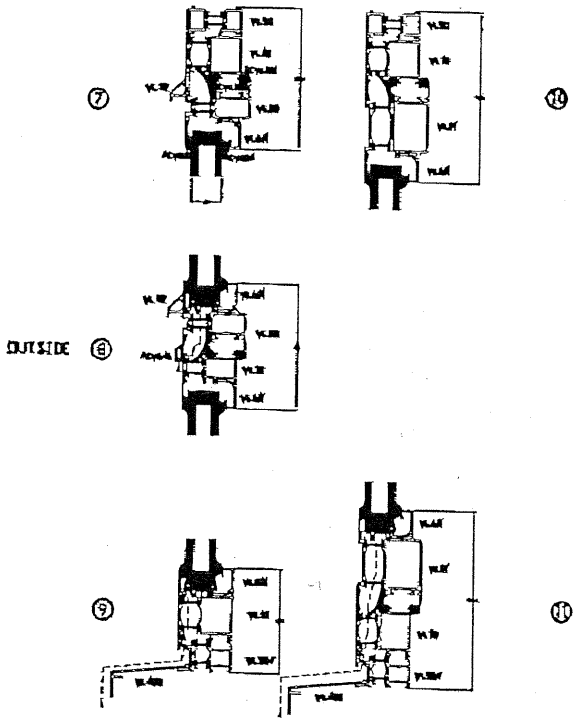
Safety test	Condition after test
One pressure pulse to pressure: P3 at – then + 2400 Pa	No parts became detached and the test specimen remained closed

Table A9. Condition of the specimen after the safety test to P3 at ±2400 Pa

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







VISOLINE OPEN IN DOUBLE DOOR SET.
VISOLINE TILT BEFORE TURN.