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Weathertightness test to BS 6375: Part 1: 2009 on a Smart Systems Ltd Visofold 1000 bi-folding door

Prepared for: Mr. M. Walford

Smart Systems Ltd

30 November 2011

Test report number 275291

UKAS TESTING

0578

Tested on behalf of BRE by

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1 Introduction

At the request of Mr. D. White of Smart Systems Ltd, Arnolds Way, Yatton, North Somerset, BS49 4UN, BRE issued proposal number 130204 on 28 September 2011. The proposal was accepted on 25 October and BRE tested a specimen bi-folding door on 23 November 2011.

The tests to methods in BS 6375: Part 1: 2009, 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: 2009[4] and BS EN's 12207[5], 12208[6], 12210[7].

The tests on the specimen were carried out under the BRE Standard Terms and Conditions of Business for testing and to the UKAS BRE Specific Procedures Series F, as BRE Job number 275291 in project number CV4942.

The tests were witnessed by:

Mr. M. Walford	Smart Systems Ltd
Mr. D. White	Smart Systems Ltd

2 Details of tests carried out

BS 6375: Part 1: 2009 specifies that the air permeability test is performed under both positive and negative test pressures and that the average of the measurements defines the results. It also specifies that water tightness test method A is used and that deflections measured during the resistance to wind load 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 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 750 Pa. Pressure (Pa)/time (min) steps were 0/15, 50/5, 100/5, 150/5, 200/5, 250/5, 300/5, 450/5, 600/5 and 750/5.

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 = 1800 Pa, P2 = 900 Pa and P3 = 2700 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

BS 6375: Part 1: 2009 classifies the results for products in the UK. For a window to be included in an exposure category the appropriate test pressures for air permeability, watertightness and resistance to wind shall be attained or exceeded. 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 specimen was tested to a UK exposure category of 1800 (1800 Pa). The classifications set in BS 6375: Part 1: 2009 for a UK exposure category of 1800 are: Air permeability at Class 2/300 Pa or Classes 3 and 4 when tested to 600 Pa, watertightness at Class 5A/200 Pa and resistance to wind load at Class at P1 1800 Pa, P2 900 Pa and P3 2700 Pa.

Clause 4 of BS 6375: Part 1: 2009 states that doorsets that are tested and classified with a wind load greater than 1200 (Pascals) shall be classified in accordance with BS EN's 12207, 12208 and 12210 for air permeability, watertightness and resistance to wind loads respectively.

When averages of the measurements of air permeability expressed as per square metre and per metre length of the opening joints on the specimen give rise to adjacent classes then the specimen shall be classified in the most favourable class (according to Clause 4.6 BS EN 12207).

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: This report has results for air permeability under positive and negative test pressures and a graph showing 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 and in drawings in the Annex of this report

Type: Aluminium frame members with three fold outwards door leafs. Reference: Smart Systems Ltd, Visofold 1000, 2700 wide mm x 2100 mm high folding door specimen.

Glazing: The leafs are all internally glazed with insulating glass units with 4 mm thick toughened glass and a 20 mm air gap. Aluminium beads retain the glazing seals and the glazing.

Seals: There is a compression type seal all around the indoor edge of the door frame. Between the leafs, at the two folds, there are seals at the exterior and interior faces. Sealant is applied at the corner of the seals and at the junction of glazing beads.

Hardware: There are four hinges on the interior face between the centre and left hand leaf (viewed from indoors), One of these hinges has a fold out handle to aid closing of those two leafs. There are four more hinges on the external face between the centre and right hand leafs and also four hinges on the leaf hand leaf to door frame. On the right hand leaf a handle operates five locking points, including two hook bolts, two espagnolette type bolts and a central bolt near the latch. A key locks this handle and associated locking points. A second handle, operates shoot bolts between the centre and left hand leafs. All locking gear is by Fuhr.

Fixings: For these tests the specimen was fixed and sealed into a wood surround frame with screws at the top, bottom and sides.

Detail: There are two drainage holes under each glazing unit. In the sub sill there are twelve slots below the opening leafs these lead through to slots in the nose of the sill.

Dimensions: 2700 wide mm x 2100 mm (overall). Area: 5.67 m²

Length of opening joint = 13.09 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 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 seven 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 an insulating glass unit. Deflections were measured on the span at the positions indicated in Figure A3.

6 Summary of test results

The test results for the 2700 mm wide x 2100 mm high specimen of Smart Systems Ltd Visofold 1000 bi-folding door are summarised in Table 1 below for an exposure category of 1800. Figures show detail of the door and detailed results are given in Annex A.

BS or BS EN	Air permeability		Watertightness		Resistance to wind loads	
	Requirement	Results	Requirement	Results	Requirement	Results
BS 6375	Class 3 or 4 to 600 Pa	**Met** * the requirement of Class 4 based on the averages of readings in positive and negative tests	Class 5A at 200 Pa	**Met & exceeded** the requirement at Class E750 at 750 Pa	Class A4 at 1800 P1 =1800 Pa P2 = 900 Pa P3 = 2700 Pa	**All met.** Class A4 at 1800

*interpretation of the results according to Clause 4.6 BS EN 12207

Table 1. Summary of weathertightness test results

7 Conclusions

When the specimen Smart Systems Ltd, 2700 mm wide x 2100 mm high specimen of Visofold 1000 bi-folding door was tested to the standards described herein it was found to be:

- When interpretation of the results was according to Clause 4.6 BS EN 12207 then the specimen was sufficiently airtight to attain Class 4 when the averages of the readings under positive and negative test pressures were considered, thus **meeting** the BS 6375: Part 1: 2009 requirements.
- Resistant to water penetration using method 1A to Class E750 up to and at 750 Pa thus **meeting and exceeding** the BS 6375: Part 1: 2009 requirements.
- Resistant to wind loads of ±1800 Pa causing deflections less than 1/150 of the span of a door stile. Resistant to repeated pressure cycles of ±900 Pa and able to sustain the corresponding safety test pressure of ±2700 Pa. The overall classification for resistance to wind load is Class A4 at 1800 (Pa) that **meets** the requirements of Class A4 in BS 6375: Part 1: 2009.

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: 2009. 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

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	5.45	0.96	0.42
100	9.17	1.62	0.70
150	12.30	2.17	0.94
200	13.86	2.44	1.06
250	16.31	2.88	1.25
300	17.06	3.01	1.30
450	24.35	4.29	1.86
600	30.64	5.40	2.34

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	8.36	1.47	0.64
100	15.25	2.69	1.16
150	20.93	3.69	1.60
200	26.78	4.72	2.05
250	31.87	5.62	2.43
300	40.76	7.19	3.11
450	65.90	11.62	5.03
600	79.81	14.08	6.10

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	1.22	0.53
100	2.16	0.93
150	2.93	1.27
200	3.58	1.56
250	4.25	1.84
300	5.10	2.21
450	7.96	3.45
600	9.74	4.22

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

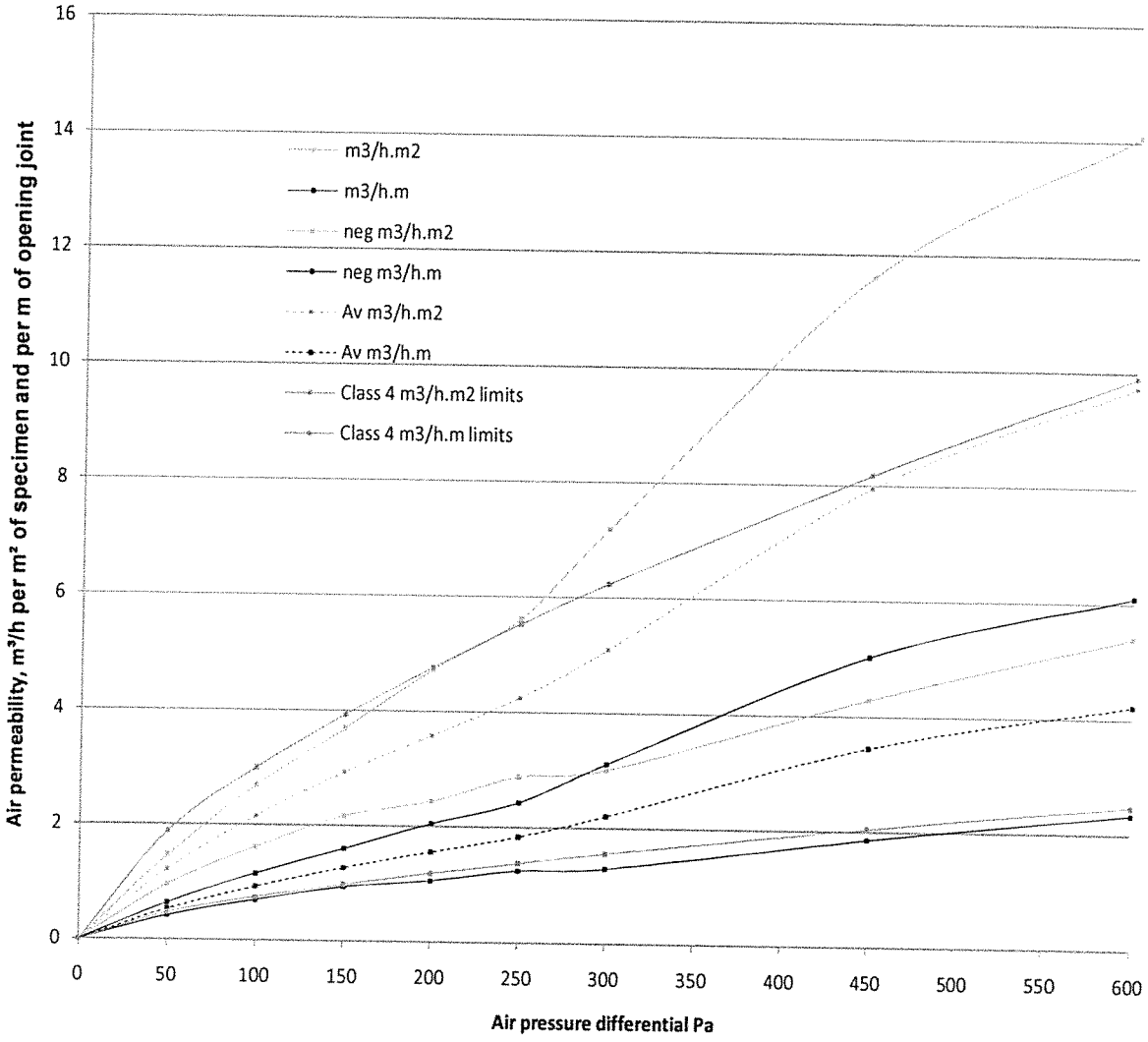


Figure A1. Air permeability under positive and negative air pressure; test results

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	Nil
300	5	Nil
450	5	Nil
600	5	Nil
750	5	Nil

Test laboratory conditions: Air pressure 1018 mb. Relative humidity 46.4%RH at 17.5°C Air temperature 17.5°C. Test chamber air temperature 18°C. Water temperature 17°C

Table A4. Watertightness test results

Resistance to wind load – Deflection test at ± 1800 Pa

Position deflection measured	Positive pressure P1 to +1800 Pa		Negative pressure P1 to - 1800 Pa	
	Deflection		Deflection	
	mm	defl./span	mm	defl./span
Left hand stile on the right hand leaf	5.96	1/331	5.79	1/341

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 A5. Deflections measured on left hand stile in the resistance to wind load test at ±1800Pa.

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

Repeated pressure	Damage or functional defects
50 cycles to P2 at ±900 Pa	None

Table A6. Damage or functional defects after repeated pressures to P2 at ±900 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	Air flow through the specimen as measured previously m³/h	Comparison to the air permeability measured previously (see Table A1)
50	5.70	5.45	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
100	9.53	9.17	
150	12.59	12.30	
200	14.60	13.86	
250	17.30	16.31	
300	18.26	17.06	
450	26.00	24.35	
600	31.07	30.64	

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	Air flow through the specimen as measured previously m³/h	Comparison to the air permeability measured previously (see Table A2)
50	8.74	8.36	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
100	15.64	15.25	
150	21.49	20.93	
200	27.30	26.78	
250	32.24	31.87	
300	41.21	40.76	
450	58.89	65.90	
600	81.38	79.81	

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 + 2700 Pa	No parts became detached and the test specimen remained closed

Table A9. Condition of the specimen after the safety test to P3 at ±2700 Pa

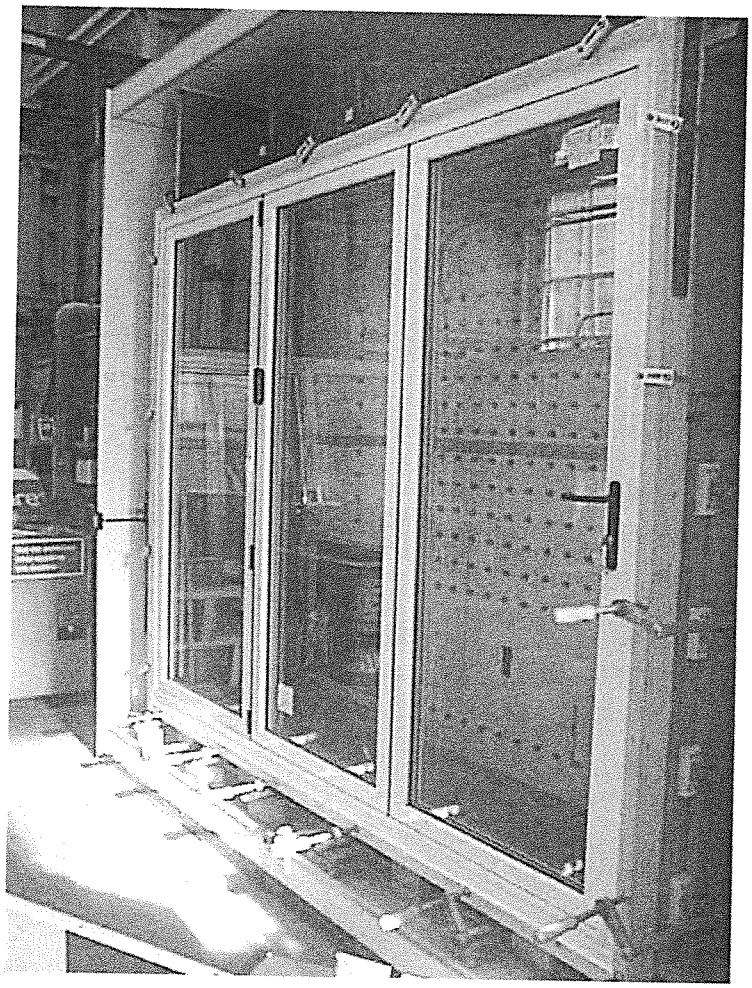


Figure A2. Smart Systems Visofold 1000 door in the BRE weathertightness test rig 'G'

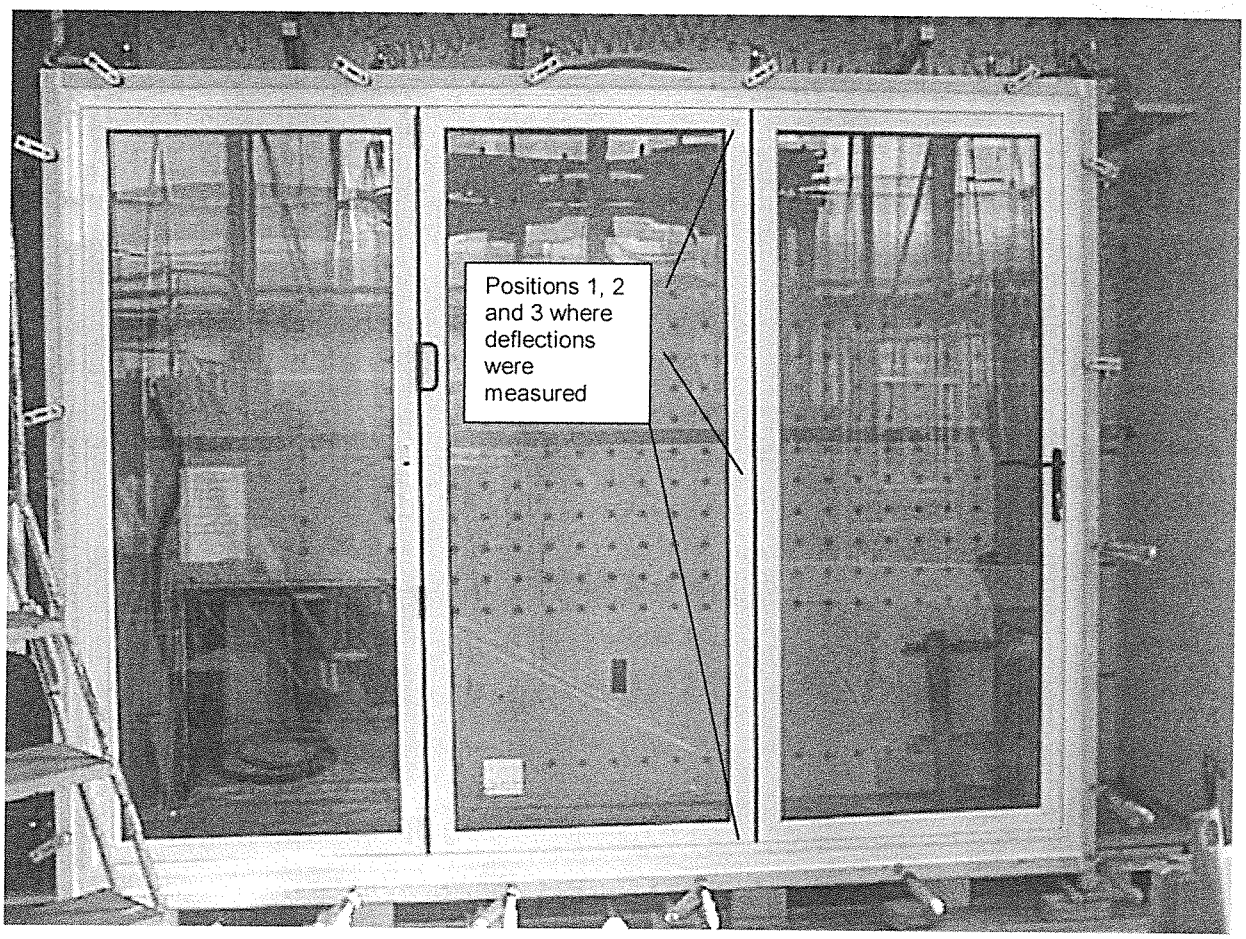
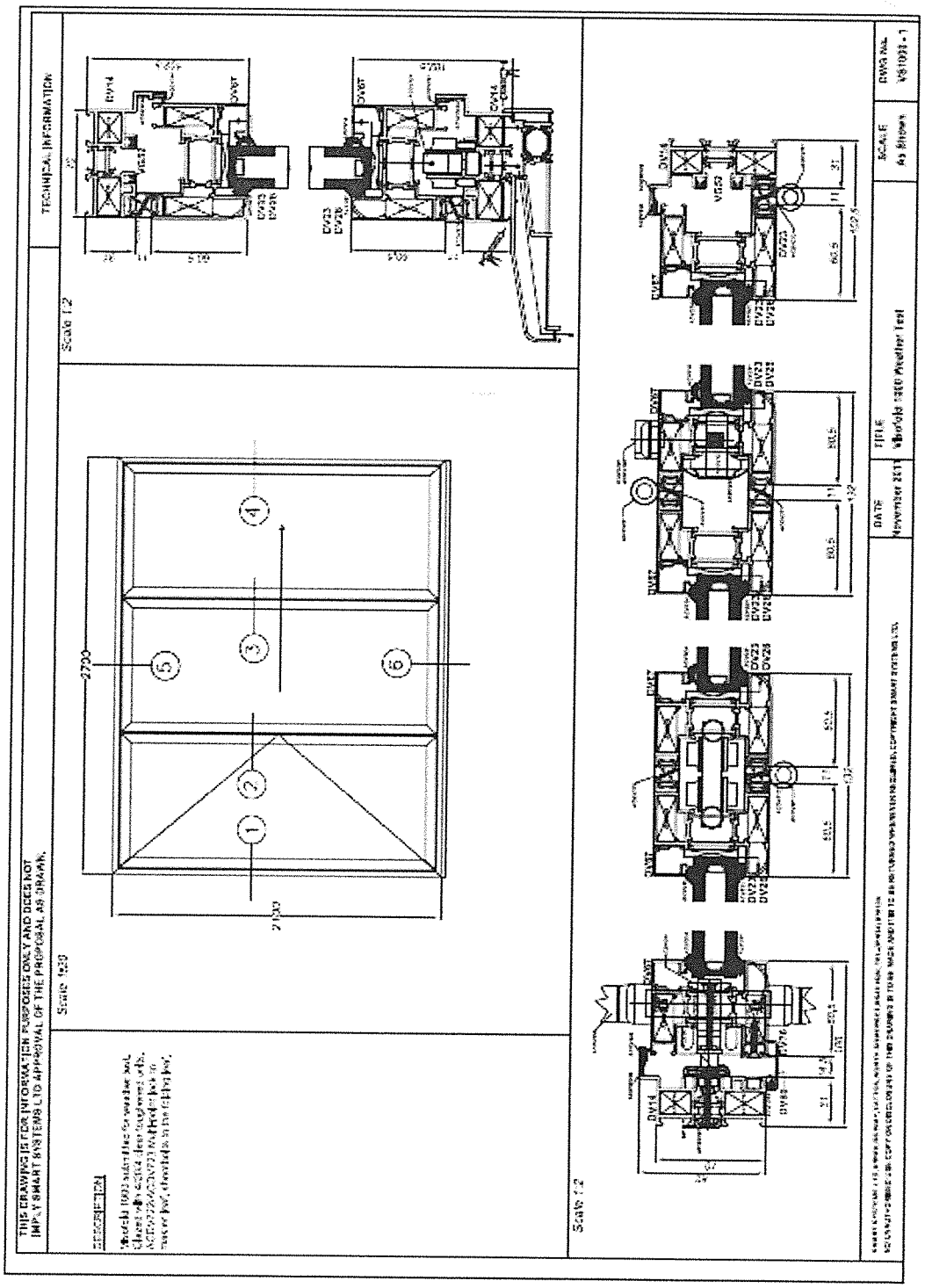


Figure A3. Smart Systems Visofold 1000 door showing points where deflections were measured



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