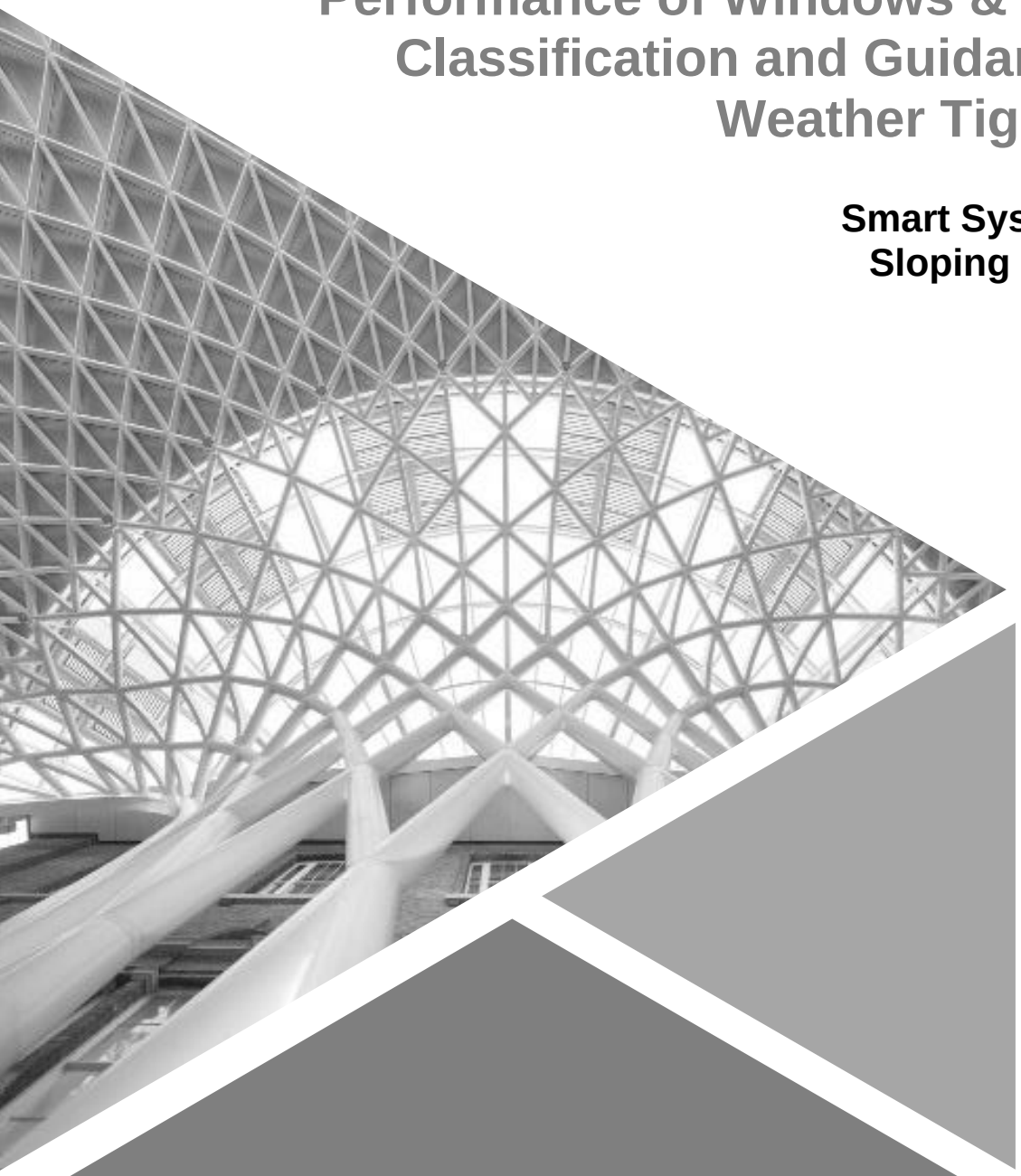
Technical Report – R4790007187
BS 6375-1:2015+A1:2016- Performance of Windows & Doors, Classification and Guidance for Weather Tightness

Smart Systems Ltd
Sloping Rooflight



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Contents

1. Introduction

This report describes tests carried in order to determine the weather tightness of the test specimen supplied as follows:

Test Details	
Customer:	Smart Systems Ltd Arnolds Way BRISTOL BS49 4QN GB
Product Tested:	2 pane, fixed, sloping rooflight
Date of Test:	23rd September 2021
Test Conducted at:	UL International (UK) Limited Halesfield 2 Telford Shropshire TF7 4QH
Test Conducted by:	D Knight Senior Laboratory Technician R Cadwallader Project Handler

Report Authorisation	
Report Compiled by:	R Cadwallader Project Handler
Authorised by:	D Potts Engineering Leader

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2. Summary of Results

The following summarises the results of testing carried out, in accordance with the relevant testing and classification standards.

The performance of the sample tested has been assessed against the criteria described in below standards.

	Test Method & Classification Standard	*Achieved Max. Test Pressure*	*Classification*
Air Permeability	BS EN 1026:2016 BS EN 12207:2000	600 Pa	4
Water Tightness	BS EN 1027:2000 BS EN 12208:2000	1500 Pa	E1500
Wind Resistance	BS EN 12211:2016 BS EN 12210:2016	2000 Pa	C5
Classification according to Table 1 of BS 6375-1:2015+A1:2016			2000

More comprehensive details are reported in Section 6.

2.1 Decision Rule

Classifications reported in Section 5 indicate that the product conforms with the relevant accuracy requirements of the testing standards (as summarised below) and the expanded measurement uncertainty (k= 2 for approximately 95% coverage probability) is no greater in magnitude than the accuracy requirements defined in Section 4 of BS EN 12207:2000 and Section 4 and Section 5 of BS EN 12210:2016.

2.2 Measurement uncertainty

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%, and for the air leakage measurements is +/- 1.60 % whereas for the wind resistance measurements is +/- 1.60 %.

2.3 Notes

* These results are valid only for the conditions under which the test was conducted

** All measurement devices, instruments and other relevant equipment were calibrated and traceable to National Standards.

2.4 Standard Deviations

* It was not possible to environmentally condition the sample and to control environmental conditions during the test due to the test being conducted outdoors.

** Due to the configuration of the test chamber, wind loading sequences during P2 & P3 were conducted with the pressure sequence in the reverse order i.e., positive then negative, as appose to negative then positive pressures.

*** Due to the high performance of the test specimen, the chamber leakage exceeded the maximum put forward in the standard (30% of the air permeability leakage rate of the sample).

3. Description of Test Sample

The description of the test sample in this section has been supplied by Smart Systems Ltd and has not been verified by UL International (UK) Limited.

See Section 7 for test sample drawings as provided by the customer.

Product range name:	Sloping Roof Light
Project name to appear on front page of the test report:	As Above
Configuration:	
Opening direction:	N/A
Product manufacturer:	Smart Systems
Is the sample typical of normal production?	Yes
Please define the closing condition of the sample: i.e. closed, fastened, latched, locked and secured etc.	Fixed
Weight of Sample including subframe (kg):	94.89 Kgs
Weight of Sash (kg)- applicable for sample tested with accordance with BS 6375-2:2009	N/A

Outer Frame			
Outer frame width:	2000mm	**Outer frame material:**	Aluminium
Outer frame height:	1100mm	**Outer frame gasket**	N/A
Outer frame Part Numbers	EHE200N	Gasket type:	N/A
Top:	N/A	Manufacturer:	N/A
Bottom:	N/A	Product name:	N/A
Lock side:	N/A	Product code:	N/A
Hinge side:	N/A	**Threshold**	N/A
Outer frame section size		Manufacturer:	N/A
Width:	91.5mm	Product name:	N/A
Depth:	105 mm	Product code:	N/A
Reinforcing:	N/A	Material:	N/A
Manufacturer:	N/A	**Outer frame joint method**	Cleated & Glued
Product name:	N/A	Head:	
Product code:	N/A	Foot:	
Material:	N/A	**Surface Finish**	

Leaf			
Leaf/Casement width:	N/A	**Leaf/ Casement material:**	N/A
Leaf/ Casement height:	N/A	**Leaf/ Casement gasket**	N/A
Leaf/ Casement Part Numbers	N/A	Gasket type:	N/A
Top:	N/A	Manufacturer:	N/A
Bottom:	N/A	Product name:	N/A
Lock side:	N/A	Product code:	N/A
Hinge side:	N/A	**Mullion:**	
Leaf/ Casement section size	N/A	Manufacturer:	Smart Systems
Width:	N/A	Product name:	Mullion
Depth:	N/A	Product code:	EHE230
Reinforcing:	N/A	Material:	Aluminium
Glazing			
Glass unit		**Glazing gasket**	N/A
Manufacturer:	Cornwall Glass	Gasket type:	N/A
Inner thickness:	6.4mm Tough Lam	Manufacturer:	N/A
Spacer material:	18mm Warm Edge	Product name:	N/A
Outer thickness:	4mm Tough	Product code:	N/A
Unit sizes:	990mm x 1089mm	**Glazing clip**	N/A
Sealant		Manufacturer:	N/A
Manufacturer:	Forgeway	Product name:	N/A
Product name:	Formoa 66	Product code:	N/A
Product code:	ACUN3610	**Glazing tape details**	N/A
		Manufacturer:	N/A
		Product name:	N/A
		Product code:	N/A

Confirmation

Customer is to confirm that the samples provided for testing are representative of standard production. Please note: the details given above, as well as the drawings supplied by the customer as confirmed as typical of normal production are not verified by UL International (UK) Limited.

Company:	Smart Systems
Name:	Steve Marshall
Date:	05/10/2021

4. Test Arrangement

4.1 Test Chamber

A window specimen, supplied for testing in accordance with the relevant British and European Standards, was mounted into a rigid test chamber. The pressure within the chamber was controlled by means of a centrifugal fan and a system of ducting and valves. The static pressure difference between the outside and inside of the chamber being measured by means of a pressure transmitter.

4.2 Instrumentation

4.2.1 Static Pressure

A pressure measurement device capable of measuring rapid changes in pressure to an accuracy within 5%, was used to measure the pressure differential across the sample.

4.2.2 Air Flow

An air flow meter mounted in the air system ducting was used to measure the airflow required to obtain pressures within the test chamber. The system has the capability of measuring airflow through the sample to an accuracy of ± 5%.

4.2.3 Water Flow

A flow meter(s), mounted in the spray frame water supply system, was used to measure water flow to the test sample to an accuracy of ± 10%.

4.2.4 Deflection

Deflection measurement devices with an accuracy of ± 5% were used to measure deflection of principle framing members. These measurement devices were mounted at mid span and as near to the supports of the members and located in such a way that any measurement was not influenced by the application of any loading to the sample. The gauges were mounted as shown in Figure 2.

4.2.5 Temperature & Humidity

A digital data logger capable of measuring temperature with an accuracy of ± 3°C and humidity with an accuracy of ± 5 %Rh was used.

4.2.6 Barometric Pressure

A digital barometer capable of measuring barometric pressure with an accuracy of ± 1 kPa was used.

4.3 Pressure Generation

4.3.1 Static Air Pressure

The air supply system comprised of a centrifugal fan assembly and associated ducting and control valves and was used to create both positive and negative static pressure differentials. The fan provided a constant airflow at the required pressure and period required for the tests.

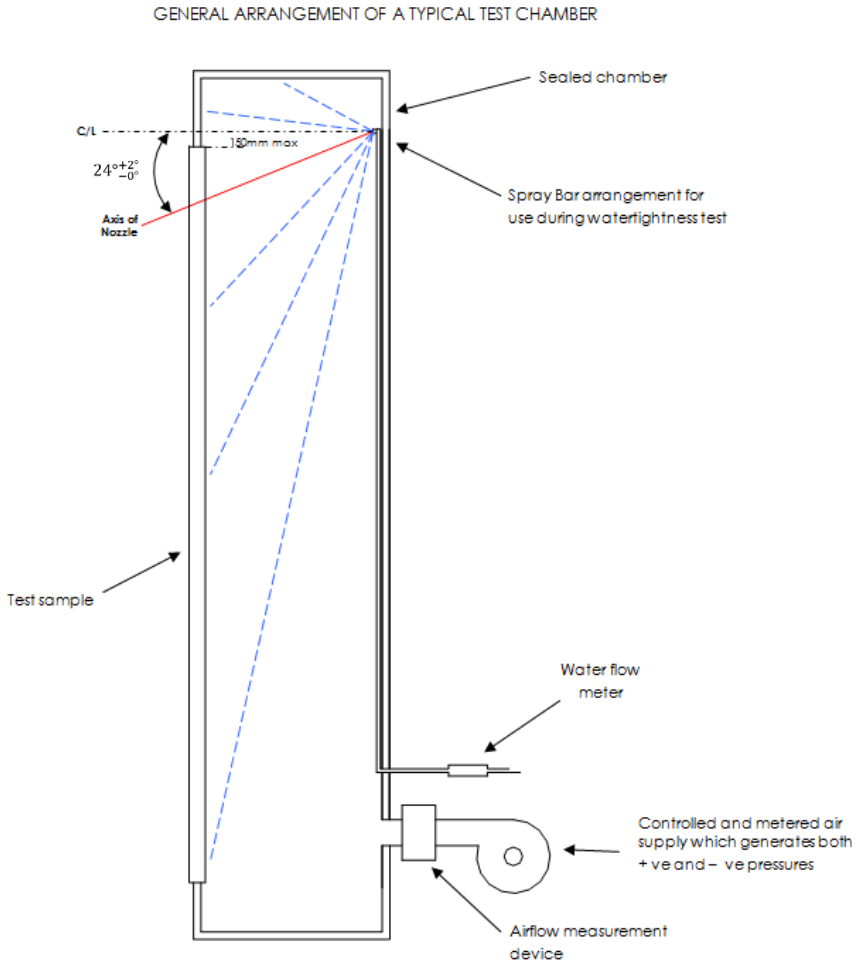
Note: References are made to both positive and negative pressures in this document, it should be noted that in these instances, positive pressure is when pressure on the weather face of the sample is greater than that on the inside face and vice versa.

4.4 Water Spray System

The spray nozzles have a circular full cone spray pattern and a spray angle of 120° (+0°/–10°) at working pressure of 2 – 3 bar and a flow rate of 2 litres/min (± 0.2 litres/min) per nozzle. The nozzles were spaced at 400 mm (± 10mm) along the axis of the spraybar and the nozzles were arranged so that the lateral distance between the outer edge of the surround and the outermost nozzles shall be greater than 50mm but not exceeding 250mm.

The nozzle line was located not more than 150mm above the topmost horizontal joint line of any moving frame or the glazing line of any fixed glazing, in order to provide complete wetting of the adjacent horizontal frame member(s). The nozzle line was also located at a distance of 250mm (+10mm/- 0mm) from the external face of the specimen as defined by the outermost external joint plane of moving parts or the glazing plane of fixed parts.

Figure 1 – Test arrangement



5. Test Procedures

Testing was carried out in accordance with the following standards:

Performance of Windows & Doors, Classification and Guidance for Weather Tightness	BS 6375-1:2015+A1:2016
Windows & Doors, Air Permeability test method	BS EN 1026:2016
Windows & Doors, Air Permeability classification	BS EN 12207:2000
Windows & Doors, Watertightness test method	BS EN 1027:2000
Windows & Doors, Watertightness classification	BS EN 12208:2000
Windows & Doors, Wind Resistance test method	BS EN 12211:2016
Windows & Doors, Wind Resistance classification	BS EN 12210:2016

5.1 Sequence of Testing

1. Air Permeability – Infiltration
2. Air Permeability – Exfiltration
3. Watertightness
4. Wind Resistance - P1
5. Wind Resistance - P2
6. Repeat Air Permeability – Infiltration
7. Repeat Air Permeability – Exfiltration
8. Wind Resistance - P3

5.2 Air Permeability - Infiltration

The air leakage of the test chamber and joints between the chamber and test sample was determined by sealing the sample with adhesive tape and polythene sheeting and measuring the air flows at positive pressure differentials of: 50, 100, 150, 200, 250, 300, 450 and 600 Pa, each step being held for at least 10 seconds.

The sample was unsealed and any opening lights were opened and closed at least once before being brought in to the closing condition defined by the manufacturer as listed in Section 3. Three pressure pulses of 660 Pa positive pressure were then applied to the test sample.

Air flows measurements were then repeated with the sample unsealed and the difference between readings being the air leakage through the test sample which was then adjusted to normal conditions as defined in BS EN 1026:2016.

5.3 Air Permeability - Exfiltration

The air permeability test was repeated using negative pressures as described in Section 5.2.

5.4 Watertightness

Any opening lights were opened and closed at least once before being brought into the closing condition defined by the manufacturer as listed in Section 3. Three pressure pulses of 660 Pa positive pressure were then applied to the test sample.

Water was then sprayed on to the sample as per section 4.4, for 15 minutes at 0 Pa. The water spray continued, and the pressure was increased in the following increments: 50, 100, 150, 200, 250, 300, 450, 600, 750, 900, 1050,1200, 1350 and 1500 Pa (each stage being held for 5 minutes).

The interior face of the sample was continuously monitored for water ingress throughout the test.

5.5 Wind Resistance

5.5.1 Wind Resistance – P1

Three pressure pulses were applied to the test sample equal to 2200 Pa positive pressure (Pressure P1 + 10%) and each peak held for at least 3 seconds. After returning to zero pressure, all sensors were then zeroed.

A peak test pressure of 2000 Pa was applied at a rate not exceeding 100 Pa/s, either incrementally or continuously. Once the peak pressure was reached, it was maintained for a period of 30 seconds, and the required frontal deflections were recorded. The pressure was then reduced to 0 Pa, at a rate not greater than 100 Pa/s, and the residual deformation was recorded 60 ± 5 secs of returning to 0 Pa.

The test was then repeated at negative pressures.

5.5.2 Wind Resistance – P2

The sample was subjected to 50 cycles including negative & positive pressures.

The first step was at a test pressure of 1000 Pa positive pressure and followed by 1000 Pa negative pressure, as was the last of the sequence of 50 cycles. The time in which the variation from – 1000 Pa and + 1000 Pa and the reverse was 7 ± 3 s, with each peak being maintained for 7 ± 3 s.

Following completion of the required 50 cycles, all moving parts of the test sample were opened and closed and note was taken of any damage or functional defects.

5.5.3 Wind Resistance – P3

The safety test consisted of one cycle of a negative and positive test pressures, with the peak test pressure being 3000 Pa and positive test pressure applied first.

The time in which the variation from 0 Pa to – 3000 Pa and back to 0 Pa was 7 ± 3 s between each stage, with the peak being maintained for 7 ± 3 s.

Negative test pressure was applied following a 7 ± 3 s rest at 0 Pa. Variation from 0 Pa to + 3000 Pa and back to 0 Pa was the same duration as for the negative test pressure P3.

Following completion of the test, the sample was checked to ensure it stayed closed and any parts of the sample which had come detached were recorded.

6. Test Results

6.1 Environmental Conditions

The initial conditions measured at the test site were as follows:

Temperature (°C)	Humidity (%rh)	Atmospheric Pressure (kPa)
16.4	85.5	100.6

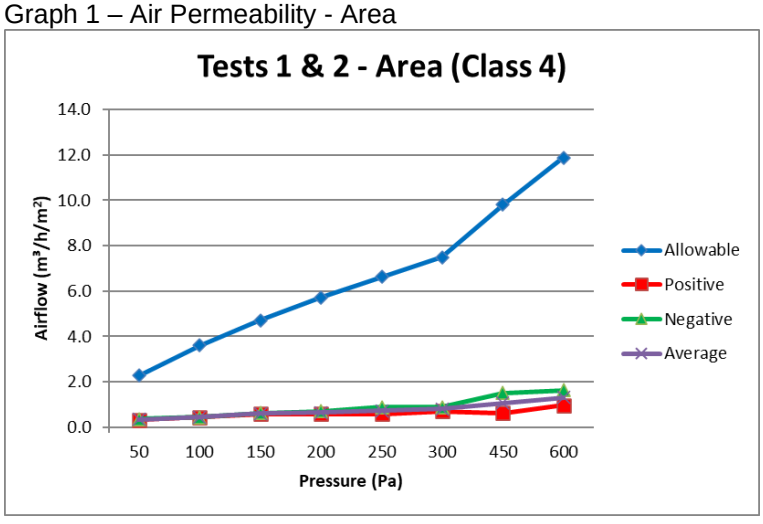
6.2 Air Permeability

Calculated area of test sample 2.28 m^2
Measured length of opening joints n/a

6.2.1 Initial Air Permeability Tests 1 & 2

Pressure Differential Pa	Air Permeability Rate Infiltration & Exfiltration Tests $m^3/hr/m^2$ - Area		
	Test No. 1	Test No. 2	Average
50	0.31	0.35	0.33
100	0.44	0.44	0.44
150	0.57	0.62	0.60
200	0.57	0.71	0.64
250	0.57	0.88	0.73
300	0.71	0.88	0.79
450	0.62	1.50	1.06
600	0.97	1.63	1.30

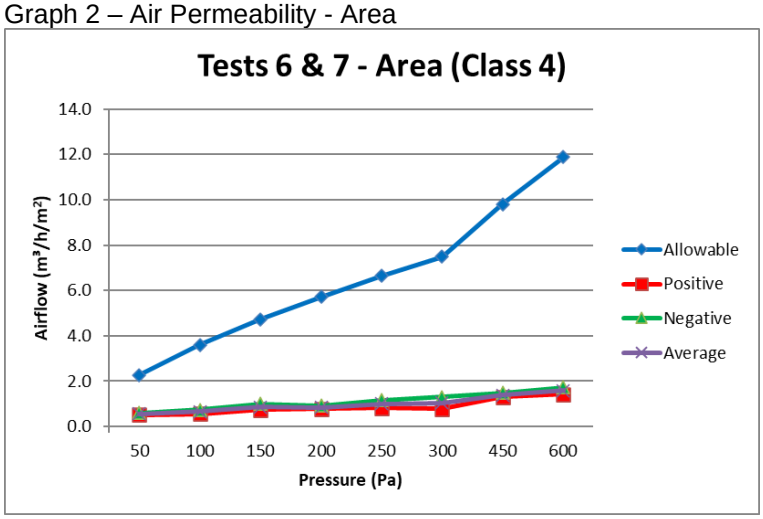
Graph 1 – Air Permeability - Area



6.2.2 Repeat Air Permeability Tests 6 & 7

Pressure Differential Pa	Air Permeability Rate Infiltration & Exfiltration Tests $m^3/hr/m^2$ - Area		
	Test No. 6	**Test No. 7**	**Average**
50	0.52	0.61	0.56
100	0.56	0.74	0.65
150	0.74	1.00	0.87
200	0.78	0.91	0.85
250	0.82	1.17	1.00
300	0.78	1.30	1.04
450	1.30	1.47	1.39
600	1.43	1.73	1.58

Graph 2 – Air Permeability - Area



6.2.3 Air Permeability – Classification

Based on Area	Based on Length of Opening Joint
4	4

Note Due to the high performance of the test specimen, the chamber leakage exceeded the maximum 30% rule and as such is a deviation from the test standard.

6.3 Watertightness Testing

6.3.1 Watertightness – Results

Water Temperature (°C)	19.7
Spray method used	1A

Observations		
Air Pressure (Pa)	**Time Stage Held (minutes)**	**Comments**
0	15	No Leakage Observed
50	5	No Leakage Observed
100	5	No Leakage Observed
150	5	No Leakage Observed
200	5	No Leakage Observed
250	5	No Leakage Observed
300	5	No Leakage Observed
450	5	No Leakage Observed
600	5	No Leakage Observed
750	5	No Leakage Observed
900	5	No Leakage Observed
1050	5	No Leakage Observed
1200	5	No Leakage Observed
1350	5	No Leakage Observed
1500	5	No Leakage Observed

6.3.2 Watertightness - Classification

Overall Classification
E1500

6.4 Wind Resistance

6.4.1 Test 4 – Wind Resistance – P1 Results

Member Under Test	Test Pressure Pa	Maximum Deflection mm	Residual Deformation mm	Deflection Class	Relative Frontal Deflection
Member A	2000	0.8	0.0	Class C	1/1380
	-2000	0.5	0.0	Class C	1/2422

Note Calculation of deformation was conducted using formula (02-(03+01)/2). Following the above tests, there was no visible damage to the test sample when viewed as required by the test standard.

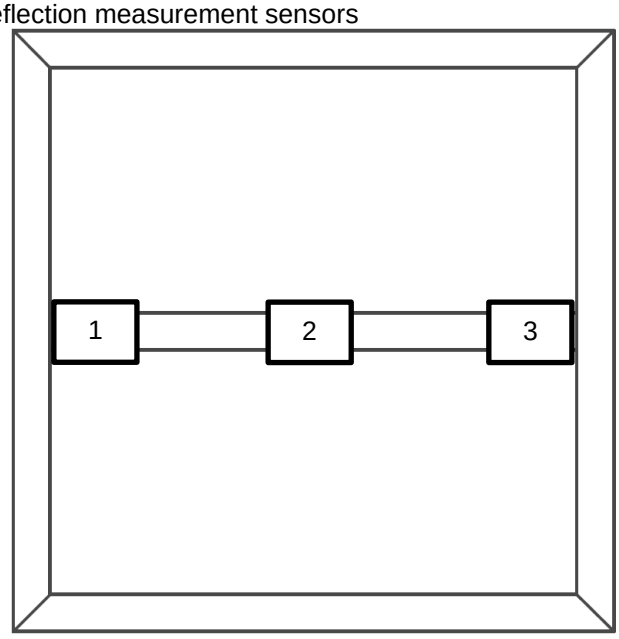
6.4.2 Test 5 – Wind Resistance – P2 Results

An inspection carried out following Test 5 – Wind Resistance, P2, after 50 cycles at both positive and negative pressure testing at 1000 Pa, showed no evidence of any permanent deformation or damage to the test sample.

6.4.3 Test 8 – Wind Resistance – P3 Results

An inspection carried out following Test 8 – Wind Resistance, P3, after both positive and negative pressure testing at 3000 Pa, showed no evidence of any permanent deformation or damage to the test sample.

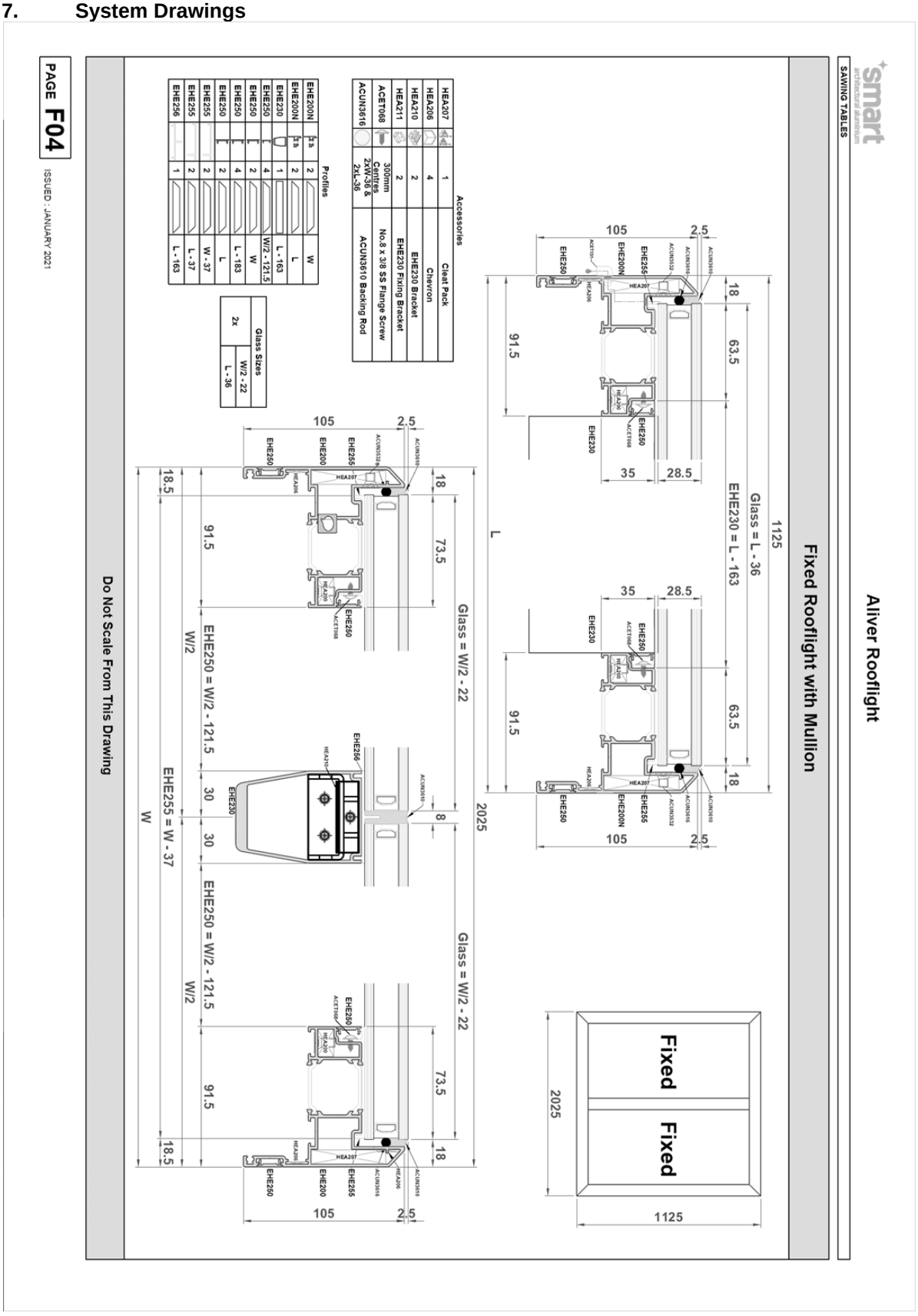
Figure 2 – Position of deflection measurement sensors



6.4.4 Wind Resistance - Classification

Overall Classification
C5

7. System Drawings



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