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**Weathertightness test
on a Tuscan Foundry
Products Ltd LR1 Lumen
Conservation roof light
to BS 6375: Part 1: 2004**

Prepared for: Mr. P. Trace

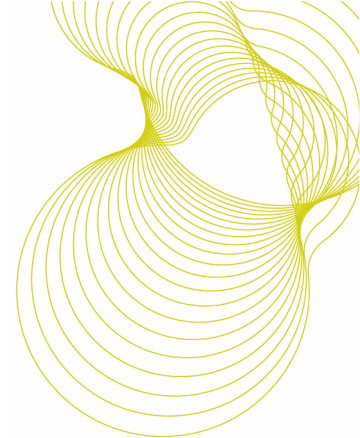
Tuscan Foundry products Ltd

15 April 2007

Test report number 235 770



0578



Tested on behalf of BRE by

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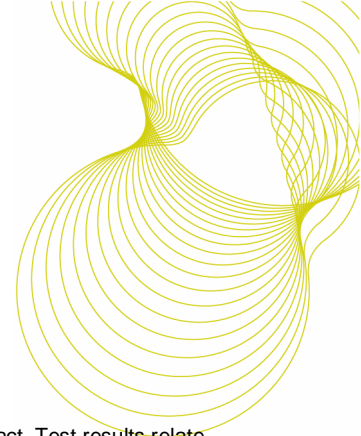
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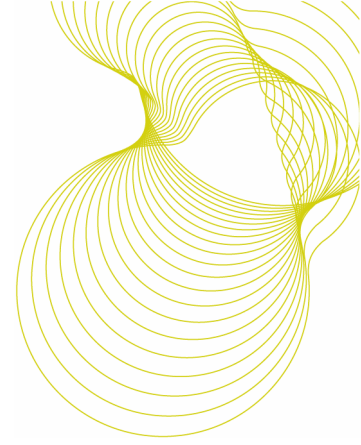
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Weathertightness test on a Tuscan Foundry Products Ltd LR1 Lumen
Conservation roof light to BS 6375: Part 1: 2004



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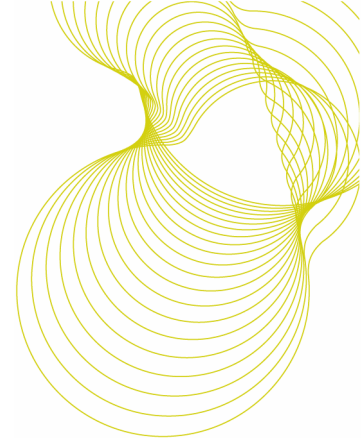
1 Introduction

At the request of Mr. P. Trace, Tuscan Foundry products Ltd, Units C1-C2 Oakendene Industrial Estate, Bolney Road, Cowfold, West Sussex RH13 8AZ, BRE issued proposal 119 705 dated 15 March 2007. This was accepted by the client on 20 March 2007 and a specimen roof light tested by BRE on 12 April 2007.

The tests assess the weathertightness of the specimen roof light with respect to air permeability, watertightness and resistance to wind loads against the performance requirements specified in BS 6375: Part 1: 2004¹.

The test method standards and the relevant Product Standard apply to windows installed in inclined roofs; BS6375: Part 1: 2004 has a scope that includes vertical windows and doors but does also apply to dormer windows set in inclined roofs.

The tests on the specimen roof light were carried out under the BRE Standard Terms and Conditions of Business and to the UKAS BRE Specific Procedures Series F, as part of BRE project number CV1702, Job Number 235770.



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 1026², 1027³ and 12211⁴ 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, the watertightness to test procedure A and that deflection of framing members be limited to 1/150 of their lengths. BS 6375: Part 1: 2004 and BS ENs 12207⁵, 12208⁶ and 12210⁷ classify the weathertightness performance of completely assembled windows of any material after testing to the methods below.

The weathertightness test comprised of three parts in the sequence:

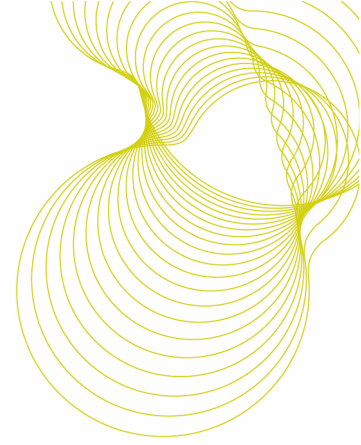
1. Air permeability to BS EN 1026: 2000; by application of a series of test air pressure differentials across the specimen window with measurement of the air permeability of it at each pressure step. The maximum positive and negative pressure differential was 600 Pa reached in pressure steps of 50, 100, 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 window 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.
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: $P1 = 2500$ Pa, $P2 = 1250$ Pa and $P3 = 3750$ 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.



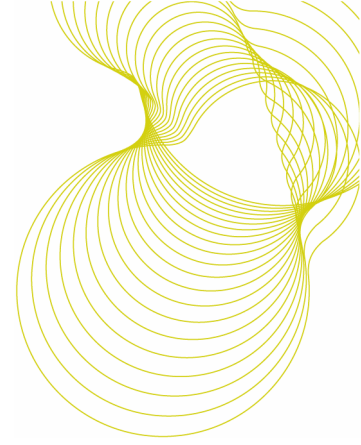
3 Classification of results

The classifications from BS 6375: Part 1: 2004 for a UK exposure category of 2000+ has air permeability at Class 2/300 Pa, watertightness at Class 7A/300 Pa and resistance to wind load at Class EXXXX, P1 2500 Pa, P2 1250 Pa and P3 3750 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 14351-1:2006⁸ states that the 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:

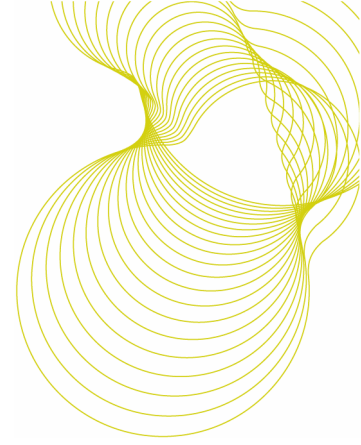
- Air permeability** BS EN 12207: 1999. The classification is based on a comparison of the air permeability of the test specimen related to both overall area and length of opening joint. There are four classes; class 4 is applicable to the most airtight specimens while class 1 describes those with most 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

For these tests the roof light specimen was fixed into an inclined position at 45° to horizontal.

- Type:** Metal framed rooflight with one top hung, open out, opening light. Reference: Tuscan Foundry Products Ltd LR1 Lumen Conservation roof light 752 mm x 592 mm, BRE Ref: 235770/1.
- Glazing:** The light is glazed from the outdoor face with two insulating glass units side by side and separated by a glazing bar. The glass units are 25 mm overall thickness with 4 mm thick clear glass and a 17 mm air gap. Sealant and glazing tape retain the glazing.
- Seals:** On the fixed frame there are primary seals and inboard of that, secondary seals; both are Neoprene and are of the compression type. The primary seal is adhered to the head of the upstand on the frame and has mitre cut top corners with a continuous outer edge. The bottom most part of the primary seal is bonded to the side parts and under-laps them. The secondary seal adheres to the metal frame and consists of 30 mm wide flat Neoprene seals at the top and sides mitre cut at the corners. The bottom section is of tubular section seal butt jointed to the sides.
- The glazing seals are; Sealant to the outside and glazing tape indoors.
- Hardware:** One winder mechanism opens and closes the light that is hung on two pivot type hinges at the top.
- Drainage:** There are two drainage holes at the bottom of the frame situated between the primary and secondary seals.
- Dimensions:** 752 mm high x 592 mm wide (overall outdoor dimension) Area: 0.45 m²
520 mm high x 415 mm wide (overall indoor dimension) Area: 0.22 m²
- Length of opening joint = 1.58 m
- Configuration:** Figure 1 shows the inside face of the roof light



5 Test rig and preparatory procedures

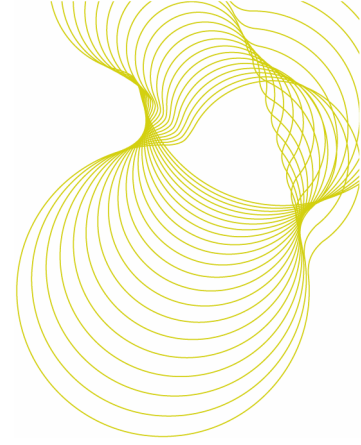
The test specimen was conditioned for at least 4 hours within temperature and humidity ranges specified in the test standards of 10°C to 30°C and 25% to 75% RH respectively.

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. The specimen and mounting face of the test rig are at 45° to horizontal.

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 units. Deflections were measured on the span at the positions indicated in Figure 1.

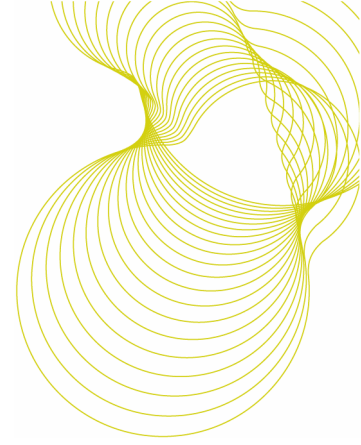


6 Summary of test results

The test results are summarised in Table 1 below for a UK exposure category of '2000+' (Actually 2500Pa).
 Figures show detail of the specimen and detailed results are given in Annex 1.

BS or BS EN	Air permeability		Watertightness		Resistance to wind loads	
	Requirements	Results	Requirement	Results	Requirements	Results
BS 6375	Class 3 or 4 to 600 Pa	Met the requirements of Class 4 based on the averages of readings under positive and negative tests	Class 7A at 300 Pa	Met & exceeded the require – ments. Class 9A at 600 Pa	Class E2500 P1 = 2500 Pa P2 = 1250 Pa P3 = 3750 Pa	All met. Class E2500

Table 1. Summary of weathertightness test results



7 Conclusions

When the specimen Tuscan Foundry Products LR1 Lumen roof light 752 mm x 592 mm, BRE Ref: 235770/1 was tested to the standards described herein the results were:

1. Air permeability – Met Class 4 based on the averages of measurements under positive and negative test pressures.
2. Watertightness – Met Class 9A at 600 Pa.
3. Resistant to wind loads of ± 2500 Pa causing deflections less than 1/150 of the span of an opening light glazing bar, resistant to repeated pressure cycles of ± 1250 Pa and able to sustain the corresponding safety test pressure of ± 3750 Pa. The overall classification for resistance to wind load is Class C5 as in BS EN 12210: 2000. This meets the class (Class 5) set in BS 6375.

8 References

1. BS 6375: Part 1: 2004. Performance of windows and doors - Classification for weathertightness and guidance on selection and specification
2. BS EN 1026: 2000. Windows and doors – Air permeability – Test method. British Standards Institution, London.
3. BS EN 1027: 2000. Windows and doors – Watertightness – Test method. British Standards Institution, London.
4. BS EN 12211: 2000. Windows and doors – Resistance to wind load – Test method. British Standards Institution, London.
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 EN14351-1:2006 Windows and doors – Product standard, performance characteristics – Part 1: windows and external pedestrian door sets without resistance to fire and/or smoke leakage characteristics. British Standards Institution, London.

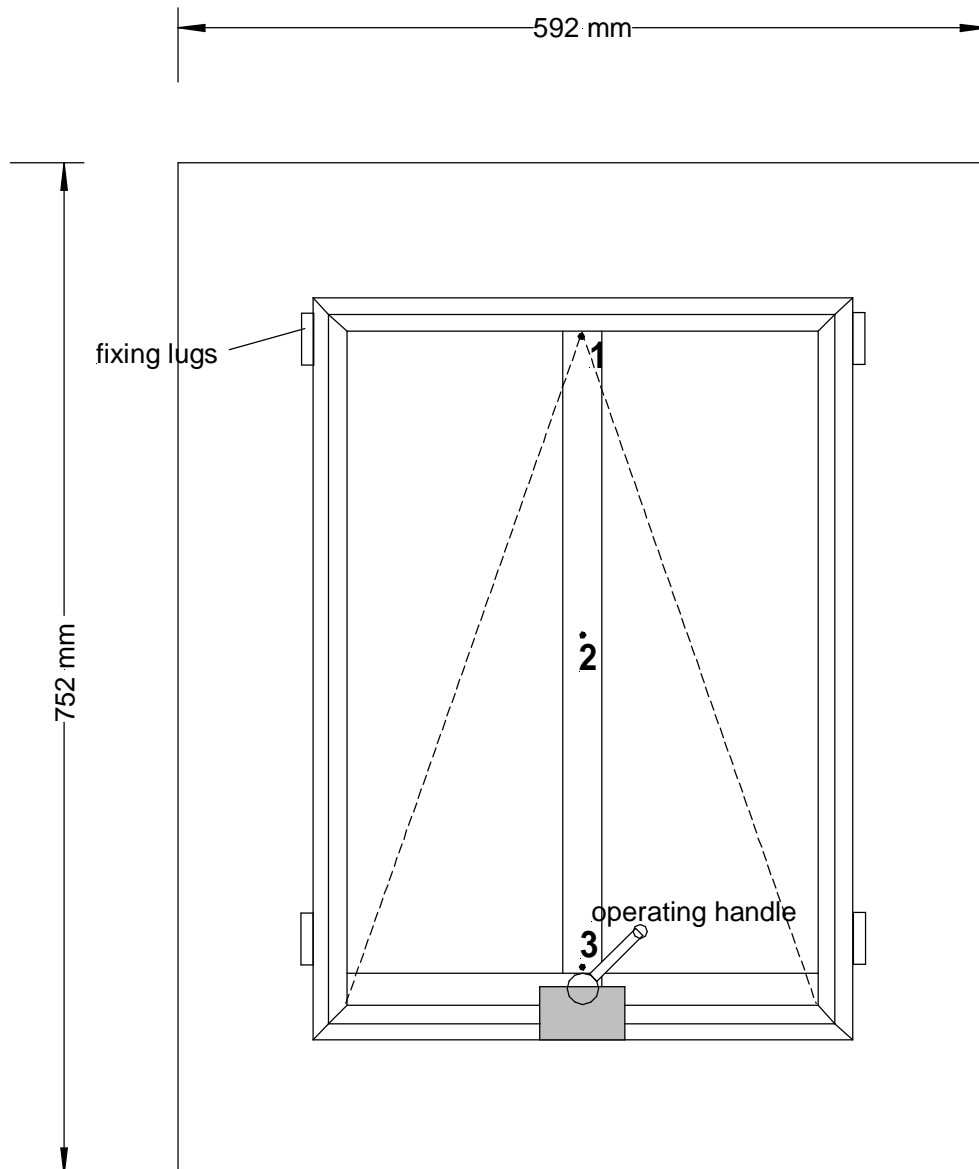
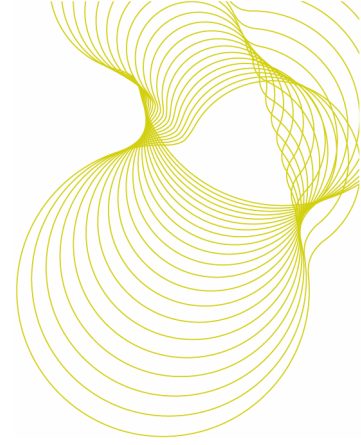
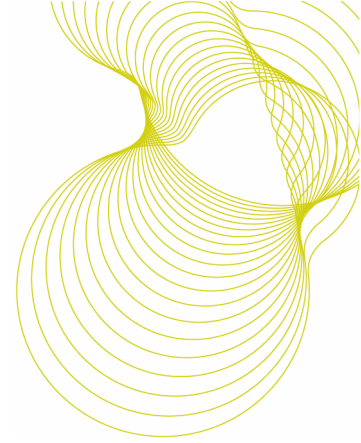


Figure 1. Outline sketch of the indoor face of the roof light showing points 1, 2 and 3 where deflections were measured



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	0.32	1.50	0.21
100	0.81	3.74	0.51
150	1.31	6.05	0.83
200	1.64	7.59	1.04
250	1.78	8.26	1.13
300	2.16	10.03	1.37
450	2.73	12.67	1.73
600	3.69	17.08	2.33

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	0.08	0.38	0.05
100	0.90	4.16	0.57
150	1.26	5.86	0.80
200	1.02	4.71	0.64
250	2.17	10.05	1.37
300	2.71	12.54	1.71
450	3.75	17.36	2.37
600	3.89	18.02	2.46

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	0.94	0.13
100	3.95	0.54
150	5.96	0.82
200	6.15	0.84
250	9.16	1.25
300	11.29	1.54
450	15.02	2.05
600	17.55	2.40

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

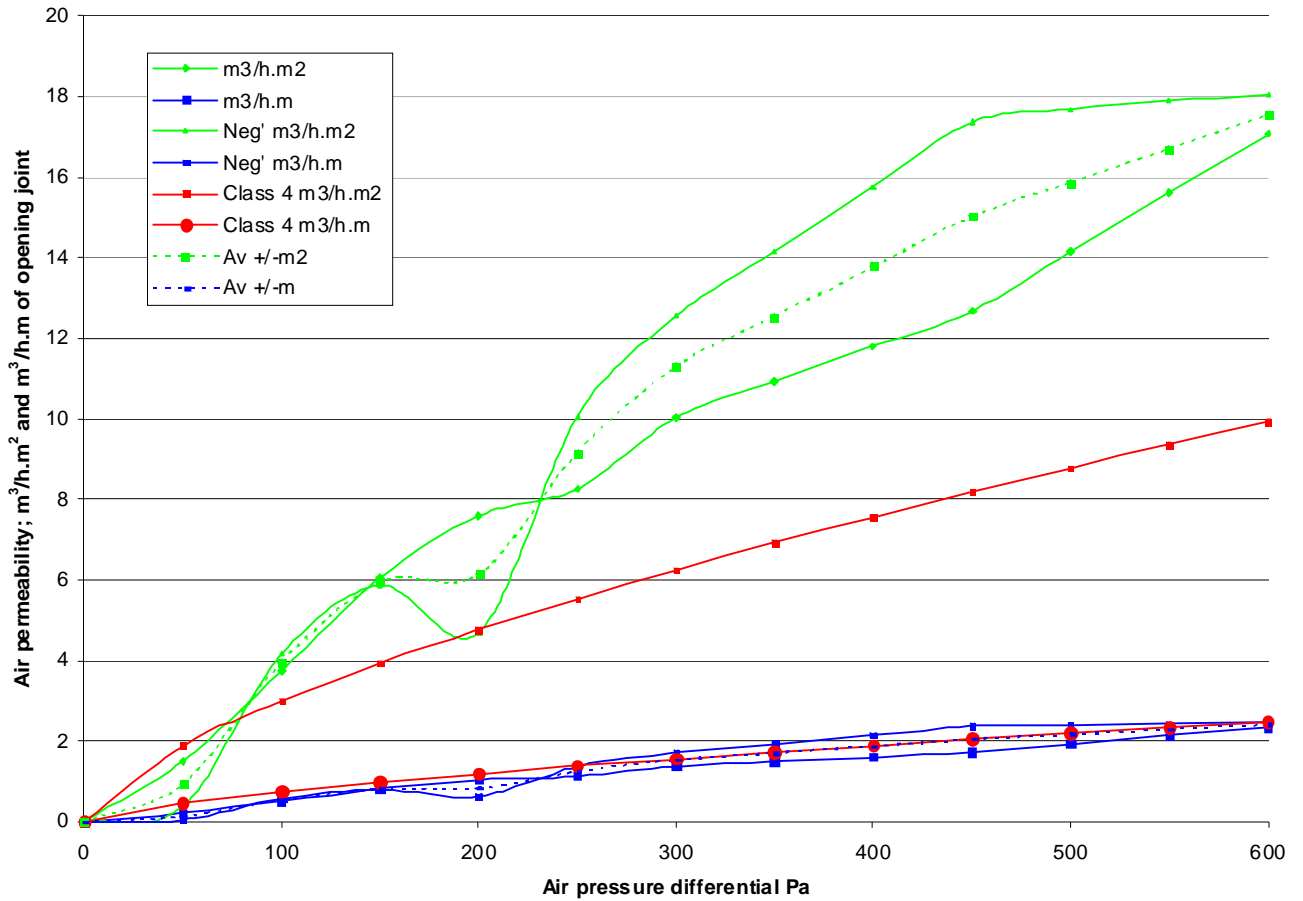
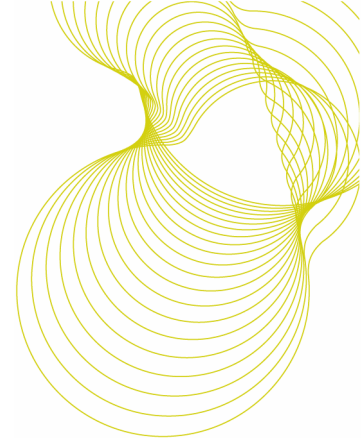
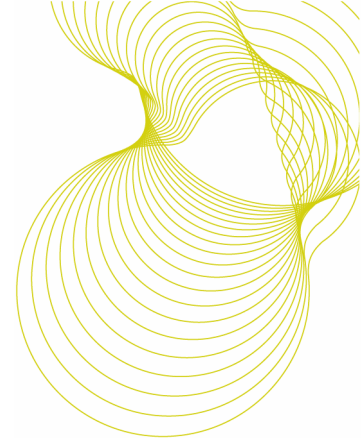


Figure A1. Test results: Air permeability under positive and negative air pressure and showing the averages



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

Test laboratory conditions: Air temperature 18.1°C. Pressure box air temperature 19°C
Air pressure 1014 mb. Relative humidity 47.4% at 18.1°C

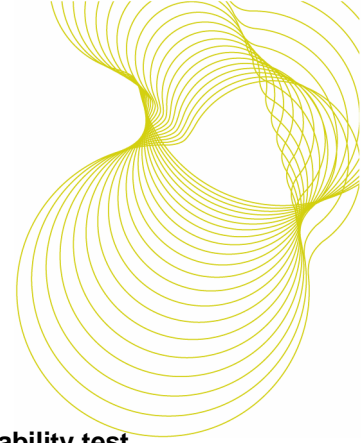
Table A4. Watertightness results

Resistance to wind load – Deflection test at ± 2500 Pa

Position deflection measured	Positive pressure P1 to +2500 Pa		Negative pressure P1 to - 2500 Pa	
	Deflection		Deflection	
	mm	defl./span	mm	defl./span
Mid height of left hand opening light stile	0.06	1/7167	0.97	1/443

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 an opening light glazing bar in the resistance to wind load test at ± 2500 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 ± 1250 Pa	None

Table A6. Damage or functional defects after repeated pressures to P2 at ± 1250 Pa

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

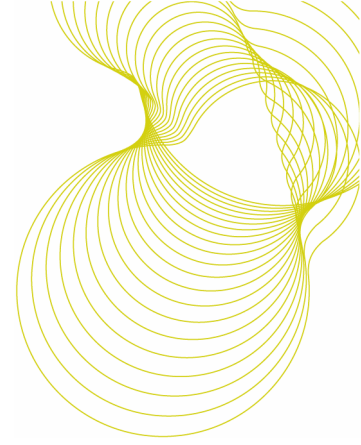
Pressure differential Pa	Air flow through the specimen m ³ /h	Comparison to the air permeability measured previously (see Table A1)
50	0.22	After the test pressures P1 and P2 were applied the amounts of air flowing through the test specimen were not significantly different to those measured previously
100	1.45	
150	0.92	
200	1.23	
250	2.09	
300	2.24	
450	3.30	
600	3.35	

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 m ³ /h	Comparison to the air permeability measured previously (see Table A2)
50	0.00	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
100	0.75	
150	1.26	
200	0.95	
250	2.18	
300	2.72	
450	3.74	
600	3.85	

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 + 3750 Pa	No parts became detached and the test roof light remained closed

Table A9. Condition of the window after the safety test to P3 at ± 3750 Pa



Figure A2. The test specimen in place on the weathertightness test rig

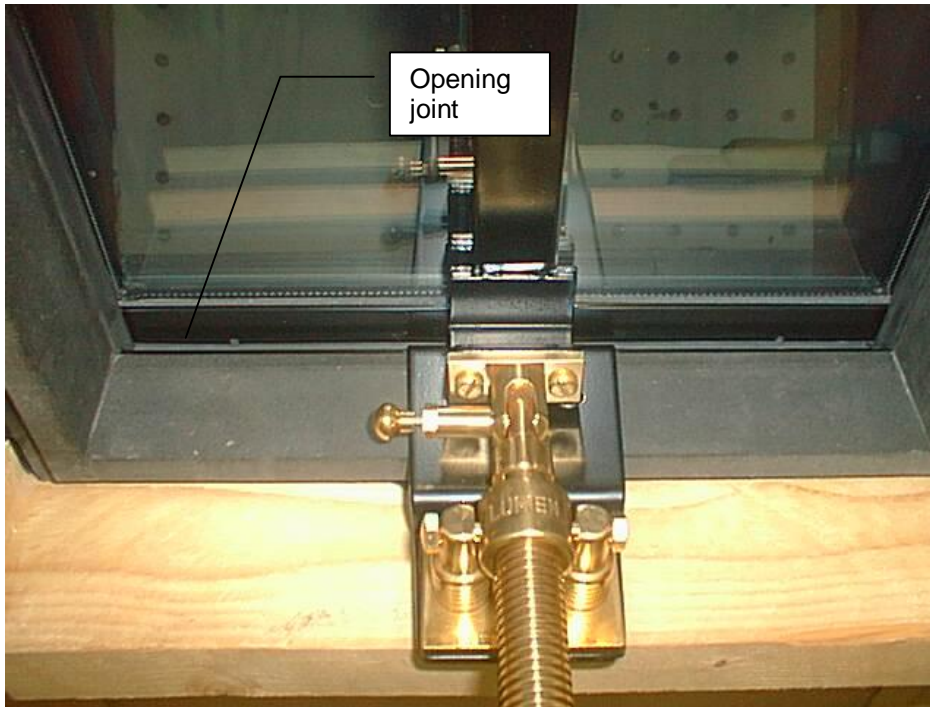
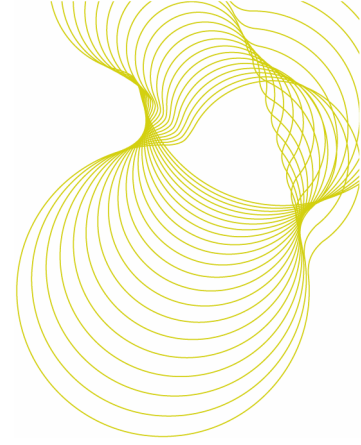


Figure A3. The roof light opener device at the bottom of the light



Figure A4. The outdoor face of the specimen roof light

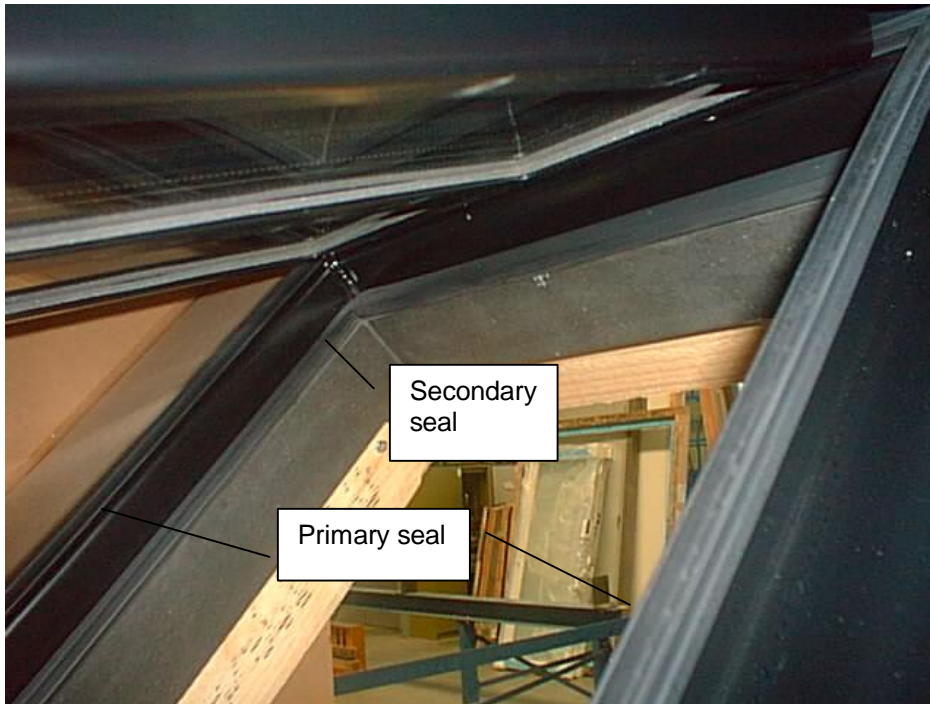
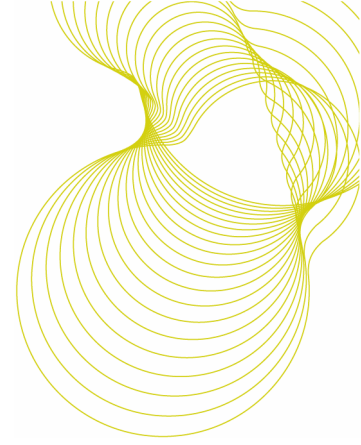


Figure A5. Showing the primary and secondary weather seals with the roof light open

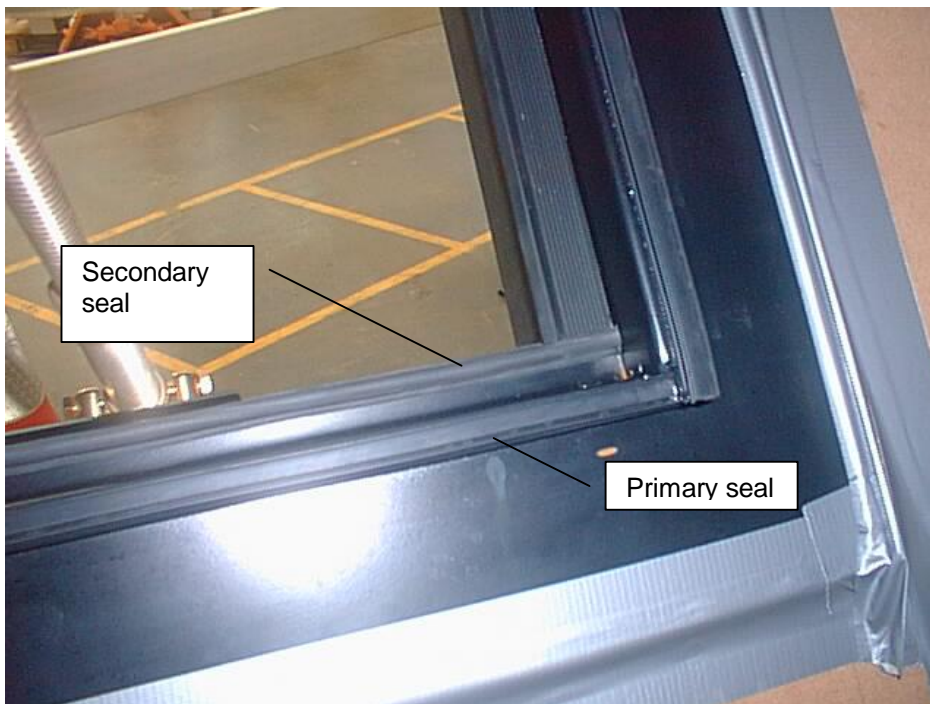


Figure A6. Showing the bottom ends of the weather seals

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