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**Weathertightness test to
BS 6375: Part 1: 2009 on
a Lumen Rooflight Ltd
Lumen EVO rooflight**

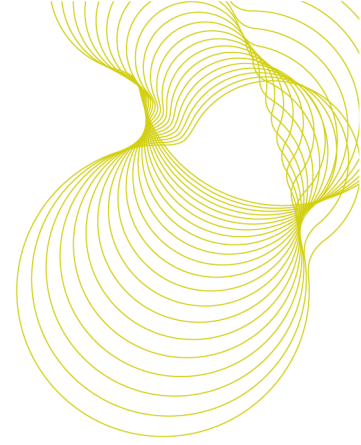
Prepared for: Mr. P. Trace
Lumen Rooflight Ltd

13 June 2011

Test report number 270647



0578



Tested on behalf of BRE by:

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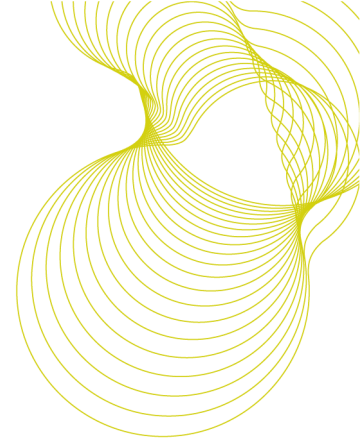
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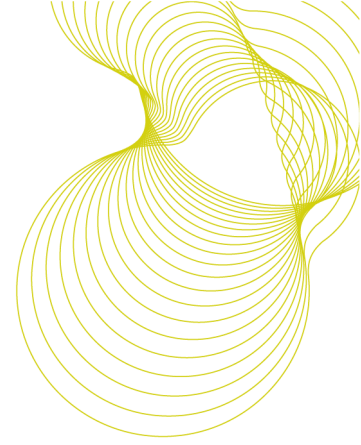
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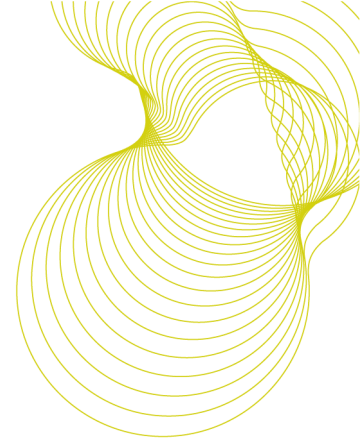
1 Introduction

At the request of Mr. P. Trace of Lumen Rooflight Ltd, Unit 8, Tamar Business Park, Tamar Way, Holsworthy, Devon, EX22 6HL, BRE issued proposal number 129195 on 11 April 2011. The proposal was accepted on 12 April and BRE tested a specimen of Lumen EVO rooflight on 10 June 2011.

The tests to methods in BS 6375: Part 1: 2009, BS EN 1026¹, 1027² and 12211³ 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: 2009⁴ and BS EN 12207⁵, 12208⁶, 12210⁷.

The tests on the specimen were carried out by Mr M. C. Pound under the BRE Standard Terms and Conditions of Business for testing and to the UKAS BRE Specific Procedures Series F, as BRE Job number 270647 in project number CV4570. The tests were witnessed by:

Mr. N. Crooks Lumen Rooflight 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 300 Pa (Pascals) reached in pressure steps of 50, 100, 150, 200, 250 and 300 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.

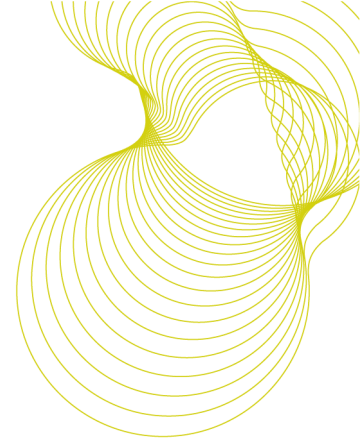
P2 50 cycles of pulsating pressure to assess performance under repeated wind loads.

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: $P1 = 2400$ Pa, $P2 = 1200$ Pa and $P3 = 3600$ 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 14351-1:2006⁸ 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 2000+ (2400 Pa). The classifications set in BS 6375: Part 1: 2009 for a UK exposure category of 2000+ for windows and doors are: Air permeability at Class 2 at 300 Pa, watertightness at Class 7A/300 Pa and resistance to wind load at Class E2400 at P1 2400 Pa, P2 1200 Pa and P3 3600 Pa.

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

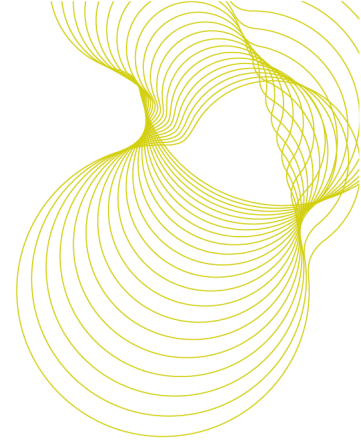
The BS EN classifications are explained below:

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.

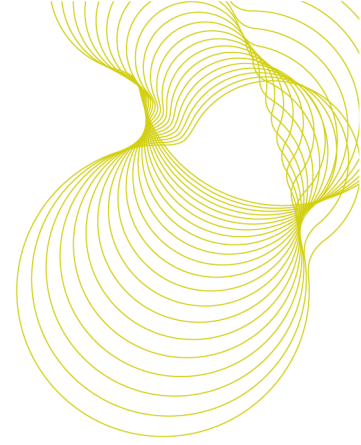
Note: This report has results for air permeability under positive and negative test pressures and a graph showing the average air permeability for them at each pressure step.



4 Test specimen

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

- Type:** Mild steel frame members with a single, open outward light and American Ash timber liners. Reference: Lumen EVO rooflight; specimen is 808 mm wide x 1207 mm high overall. Drawings and photographs in the Annex of this report show cross sections of the frame members and rooflight details.
- Glazing:** The light is glazed with an insulating glass unit with 4 mm thick toughened glass, a 16 mm wide air gap and 4 mm thick toughened glass.
- Seals:** The rooflight frame has a compression type seal with mitre cut corners. The opening light frame also has a compression seal with butt joints. Glazing seals are dry gasket type.
- Hardware:** One handle operates two shoot bolts that act horizontally into keeps at the left and right bottom corners of the light. There are two hinges at the head of the rooflight and two Speciality Fasteners and Components Ltd gas struts to hold the light open. A trickle ventilator is fitted near the handle on the opening light frame; For tests the ventilator was removed and the holes through the frame masked off with tape.
- Fixings:** For these tests the specimen was fixed with four wood screws per side and sealed into a simulated roof with MDF decking, timber rafters and noggins.
- Dimensions:** 808 mm wide x 1207 mm long (overall). Area: 0.975 m²
- Opening light is 625 mm wide x 1012 mm long Area: 0.633 m² (the exposed area indoors between rafters and noggins)
- Length of opening joint (measured at indoor face) = 2.784 m
- Tested with the rooflight at an angle of 45° to horizontal to simulate an installation in a pitched roof.



5 Test rig and preparatory procedures

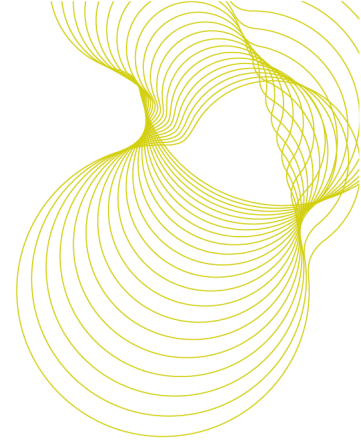
The test specimen was conditioned for at least 4 hours within temperature and humidity ranges specified in the test standards of 10°C to 30°C and 25% to 75% RH respectively.

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 enclosed in the box.

A spray bar with three full circular cone nozzles 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 1A.

Transducers were mounted on independent supports to measure deflections of a frame member. Deflections were measured on the span at the positions indicated in Figure A3.

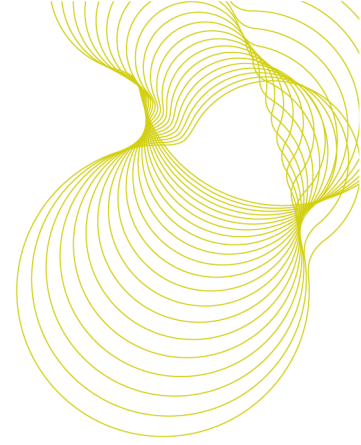


6 Summary of test results

The test results are summarised in Table 1 below. Figures show detail of the Lumen Evo rooflight and detailed results are given in Annex A.

BS	Air permeability		Watertightness		Resistance to wind loads	
	Requirements	Results	Requirement	Results	Requirements	Results
BS 6375	Class 2 at 300 Pa	Met the requirements of Class 2 for the average of positive and negative test results	Class 7A at 300 Pa	Class E750 at 750 Pa Met & exceeded Class 7A	Class E2400: P1 = 2400 Pa P2 = 1200 Pa P3 = 3600 Pa	Met all of the requirements for Class E2400

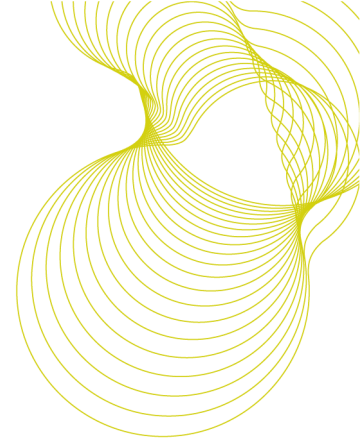
Table 1. Summary of weathertightness test results



7 Conclusions

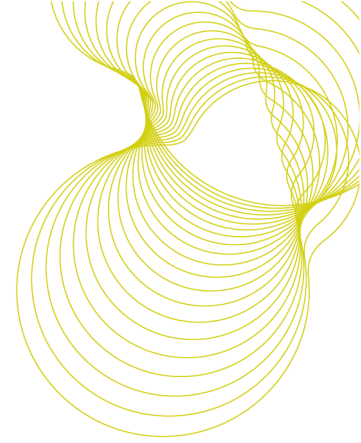
When the specimen Lumen Rooflight Ltd, 808 mm wide x 1207 mm high, Lumen EVO rooflight was tested to the standards described herein to UK exposure category '2000+' (2400 Pa) it was found to be:

- Sufficiently airtight to attain Class 2 based on the averages of results under positive and negative test pressures thus meeting the BS 6375: Part 1: 2009 requirements for Class 2 at 300 Pa.
- 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 for Class 7A at 300 Pa.
- Resistant to wind loads of ± 2400 Pa causing deflections less than 1/150 of the span of a frame member. Resistant to repeated pressure cycles of ± 1200 Pa and able to sustain the corresponding safety test pressure of ± 3600 Pa. The overall classification for resistance to wind load is Class E2400 Meeting the requirements of BS 6375: Part 1: 2009.
- The Lumen EVO rooflight specimen meets all the criteria for a UK exposure category of 2000+ (2400 Pa).



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 A. 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 m of opening joint on the specimen m ³ /h.m
50	10.32	16.32	3.71
100	13.93	22.02	5.00
150	18.21	28.78	6.54
200	21.39	33.82	7.68
250	23.82	37.66	8.56
300	26.99	42.67	9.69

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 m of opening joint on the specimen m ³ /h.m
50	11.08	17.50	3.96
100	17.95	28.39	6.45
150	21.90	34.62	7.87
200	25.76	40.72	9.25
250	29.93	47.31	10.75
300	33.28	52.62	11.95

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 m of opening joint on the specimen m ³ /h.m
50	16.91	3.84
100	25.21	5.73
150	31.70	7.21
200	37.27	8.47
250	42.49	9.66
300	47.65	10.82

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

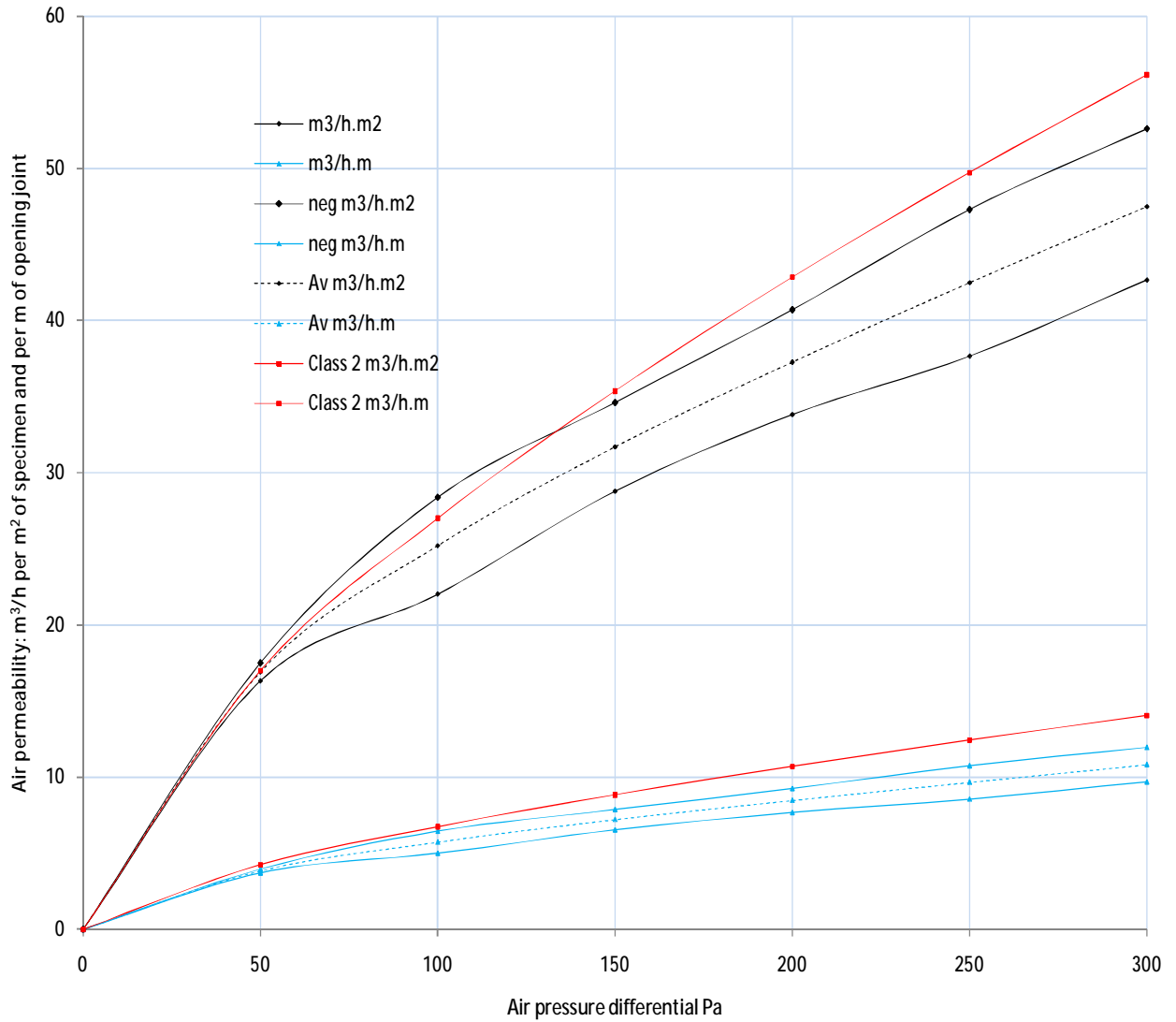
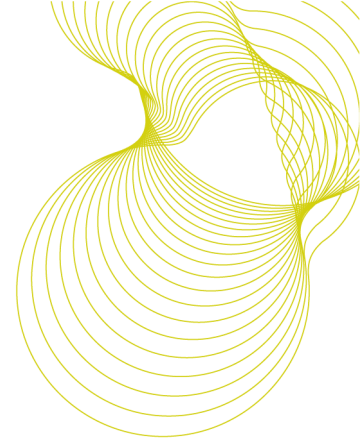
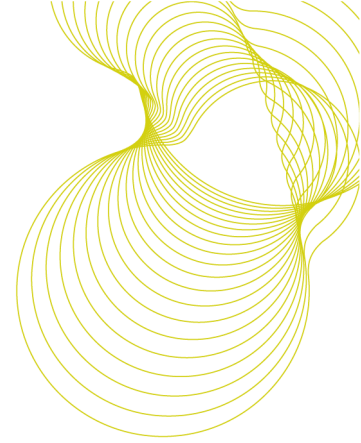


Figure A1. Test results: Air permeability under positive and negative air pressure; showing limits and averages of air permeabilities measured under positive and negative test pressures



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	Nil
600	5	Nil
750	5	Nil

Test laboratory conditions: Air temperature 20.3°C. Test chamber air temperature 19.3°C
Air pressure 1003 mb. Relative humidity 43.3% at 20.3°C. Water temperature 16.5°C

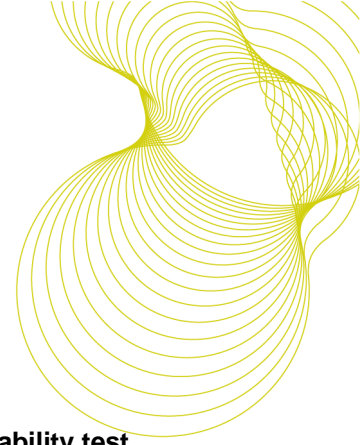
Table A4. Watertightness test results

Resistance to wind load – Deflection test at ± 2400 Pa

Position deflection measured	Positive pressure P1 to +2400 Pa		Negative pressure P1 to - 2400 Pa	
	Deflection		Deflection	
	mm	defl./span	mm	defl./span
Left hand stile on opening light	0.21	1/2367	1.05	1/473

Note: The deflection at the mid-point of a member is measured relative to its ends, e.g. with reference to Figure A3: 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 frame member in the resistance to wind load test at ± 2400 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 ± 1200 Pa	None

Table A6. Damage or functional defects after repeated pressures to P2 at ± 1200 Pa

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

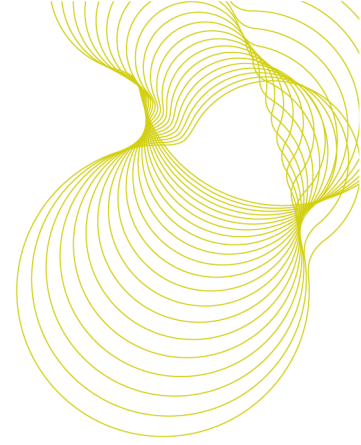
Pressure differential Pa	Air flow through the specimen m ³ /h	Comparison to the air permeability measured previously (see Table A1)
50	9.95	After the test pressures P1 and P2 were applied the amounts of air flowing through the test specimen were not significantly different to those measured previously
100	13.84	
150	16.95	
200	19.46	
250	21.96	
300	23.87	

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	10.61	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	15.86	
150	19.55	
200	23.13	
250	26.87	
300	32.54	

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 + 3600 Pa	No parts became detached and the test specimen remained closed

Table A9. Condition of the specimen after the safety test to P3 at ±3600 Pa



Figure A2. The test specimen installed in the BRE 'G' Weathertightness test rig showing points where deflections were measured.

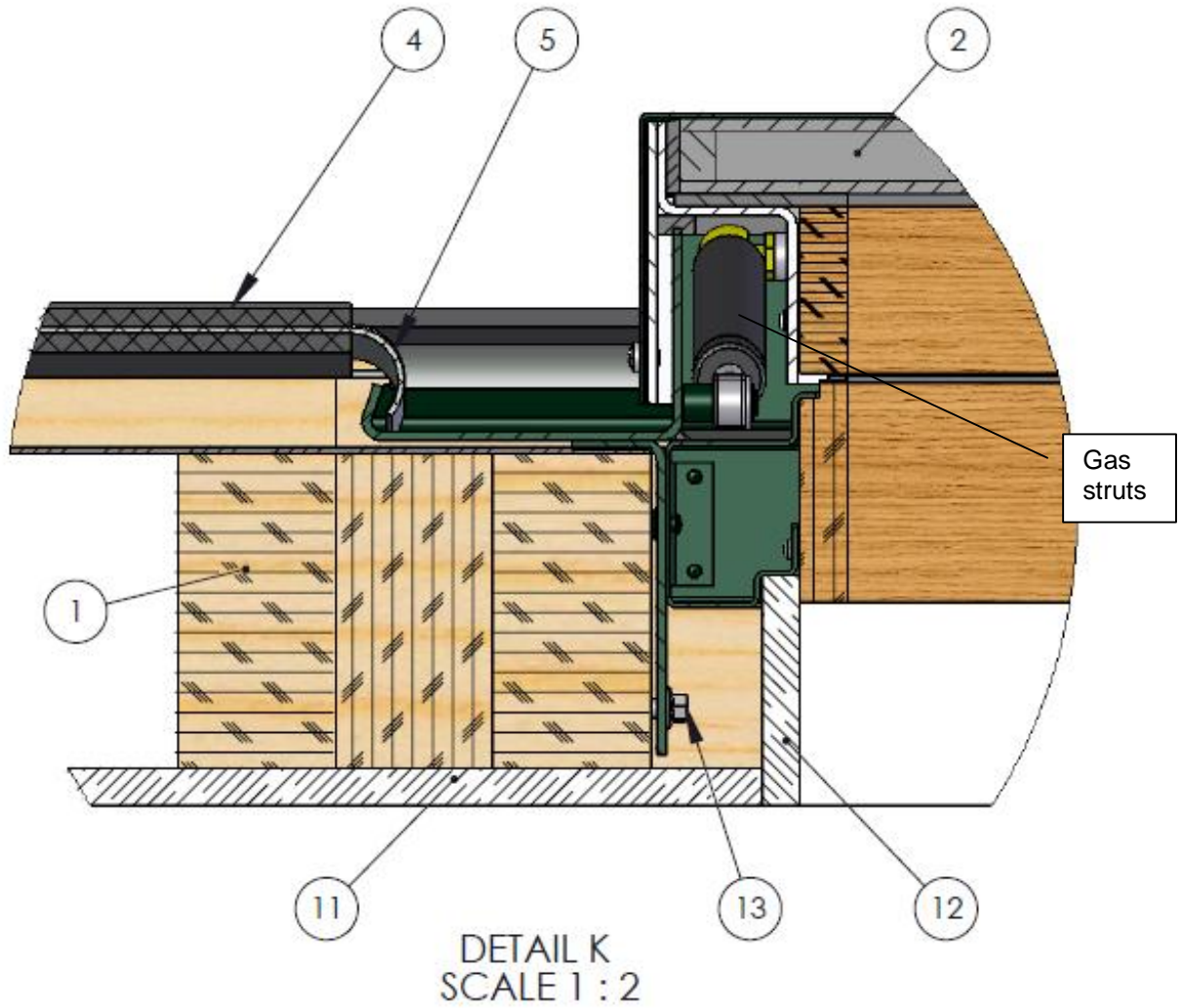
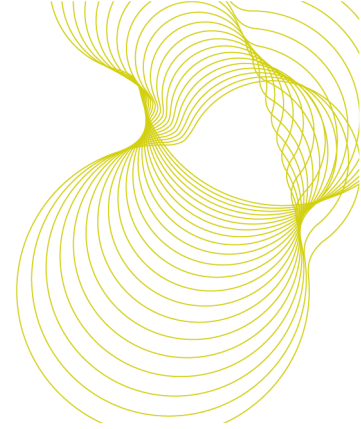


Figure A3. Cross section of the side frame members and fitment to roof

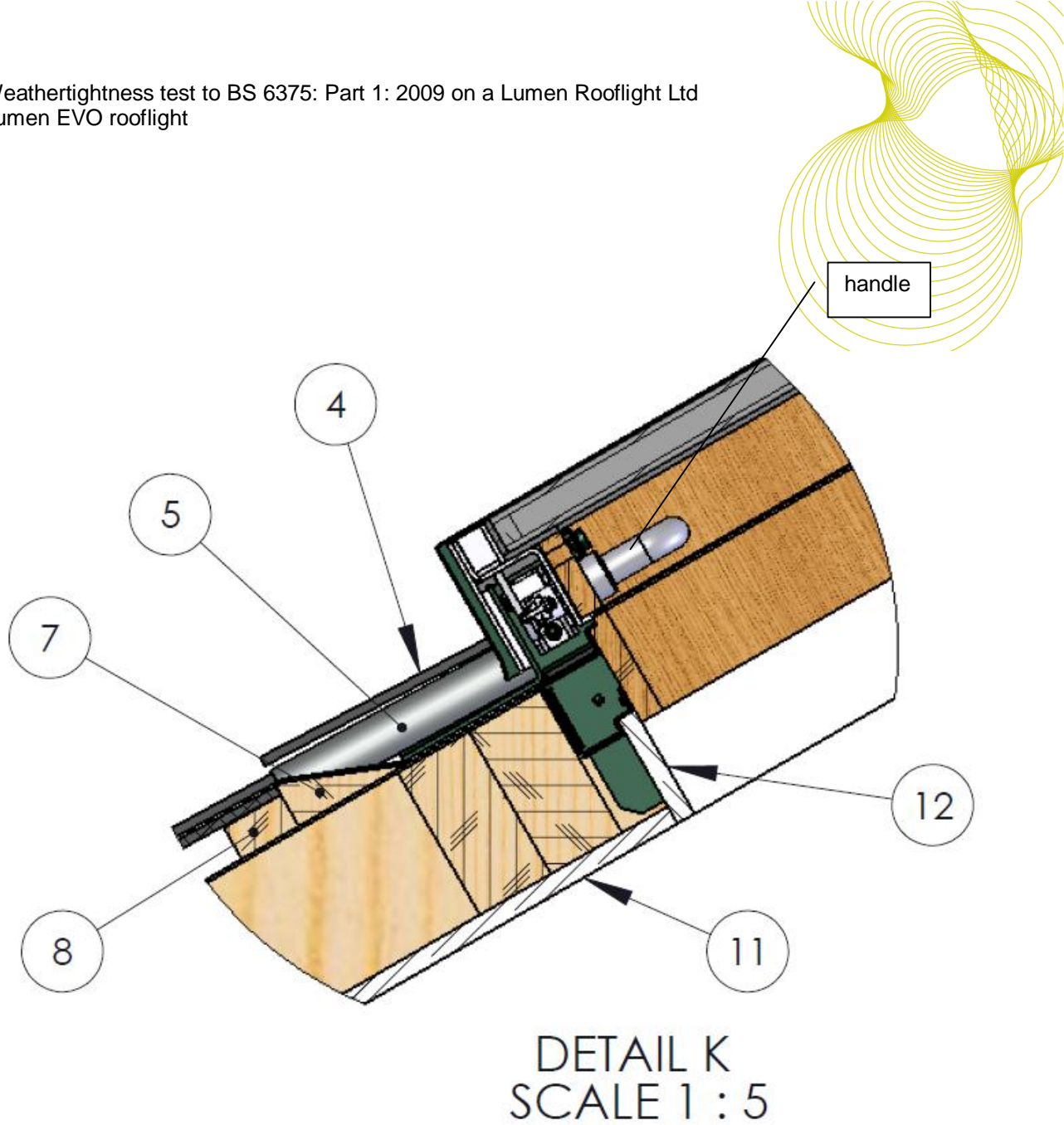


Figure A4. Details of the bottom (handle) end of the Lumen EVO rooflight.

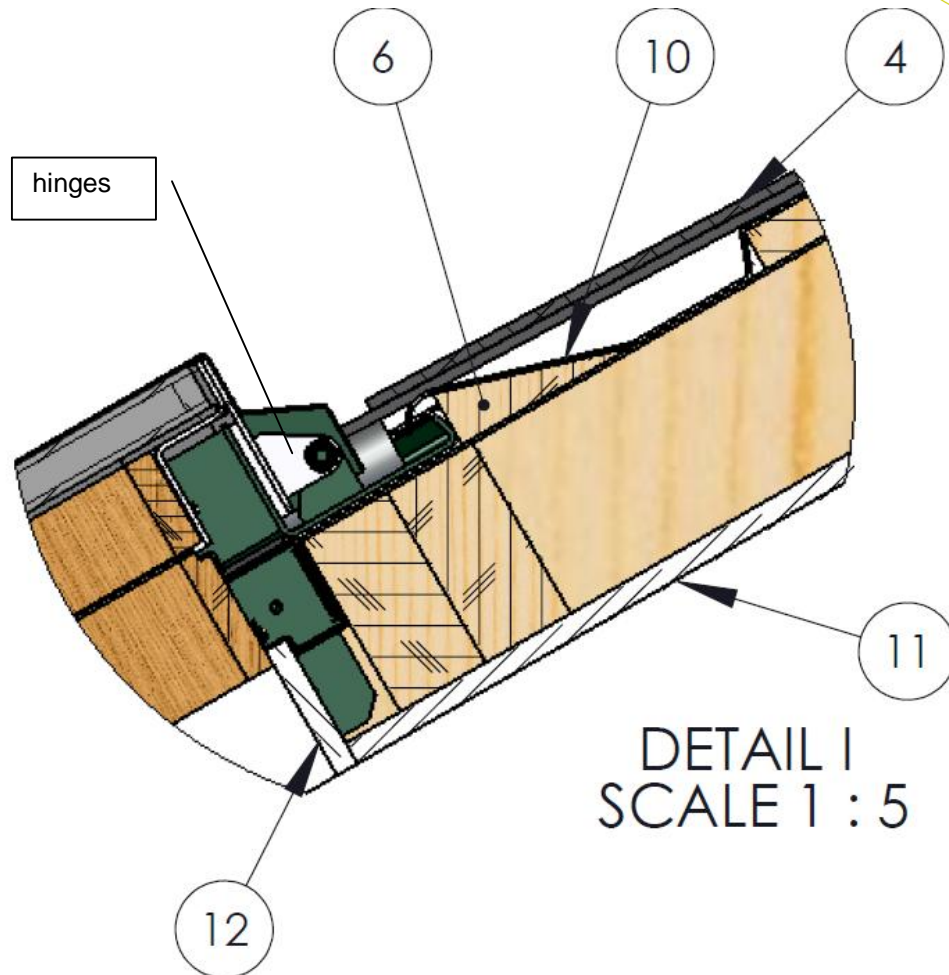
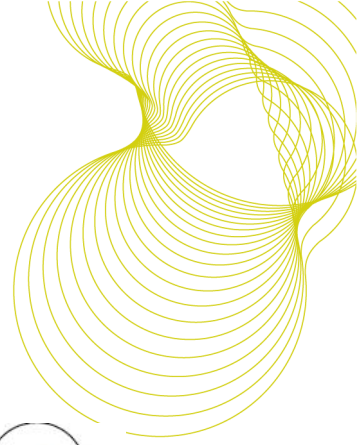


Figure A5. Details of the top (hinge) end of the Lumen EVO rooflight

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