

**Air permeability,
watertightness and
resistance to wind load
tests on a Euroclad
Façade Division's
Linear 1 rainscreen
facade system test wall**

Prepared for: Mr. N. Jenkins

Euroclad Façade Division

18 August 2006

Test report number 225672 &
228540

Tested by

Name Malcolm Pound
Position Laboratory Manager
Date 18 July 2006



Signature

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Approved on behalf of BRE

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1 Introduction

At the request of Mr. N Jenkins, Operations and Technical Manager of Euroclad Facades Division, 84/85 Seawall Road, Cardiff, CF24 5TH, BRE issued proposals 225672 and 117073 on 4 October 2005 and 27 February 2006 respectively. The proposals were accepted on 17 October 2005 and 2 March 2006 respectively, the specimen constructed at BRE on 10/11 July and tested on 18 July 2006.

The tests to methods in BS EN 12153¹, 12155² and 12179³ are based on CWCT Standard for systemised building envelopes⁴ and measure the weathertightness of the complete test assembly. The test assembly comprised of a sealed backing support wall with Linear 1 rainscreen installed to the exterior face. Weathertightness is measured in terms of air permeability, watertightness and resistance to wind load and classification of the results is based on BS EN 12152⁵ and BS EN 12154⁶, 13116⁷ and guidance in NHBC Standards Chapter 6.9 Curtain walling and cladding⁸.

In this case the maximum test pressures used for the test wall are 600 Pa (Pascals) for air permeability, 750 Pa for watertightness and 2000 Pa in the resistance to wind load test (service).

The tests on the specimen wall were carried out by M. C. Pound, BRE under the BRE Standard Terms and Conditions of Business as part of BRE Job numbers 225672 and 228540 in project numbers CV0452 and 0985 respectively. The tests were witnessed by:

Mr Melvin Noon	National Sales Manager	Euroclad Facades Division
Mr Allan Allmond	NHBC	

2 Details of tests carried out and of classification

The weathertightness test was carried out to the requirements of BS EN 12153, 12155 and 12179 for air permeability, watertightness and resistance to wind load as below and with some reference to the CWCT Standard for systemised building envelopes:

1. Air permeability to BS EN 12153: 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 Pascals.
2. Watertightness to BS EN 12155: 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 900Pa. Pressure (Pa)/time (min) steps were 0/15, 50/5, 100/5, 150/5, 200/5, 300/5, 450/5, 600/5 and 750/5.
3. Resistance to wind load to BS EN 12179: 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 tests includes a deflection test, repeat air permeability and watertightness tests and an increased load test. For the purpose of the resistance to wind load test two test pressures are defined:

A design wind load, in this case 2000 Pa; was applied to measure the deflections of parts of the test specimen.

Note: The repeat air permeability and watertightness tests are integral parts of the resistance to wind load test and its significance is as an indicator of damage that may occur during that test.

Classification of the results after testing to the forgoing standards is based on BS EN's 12152, 12154 and 13116 for air permeability, watertightness and resistance to wind loads respectively with reference to The Building Regulations and NHBC Standards Chapter 6.9 Curtain walling and cladding 2005.

3 Test specimen

The general details about the specimen wall supplied and constructed by Euroclad Facades Division for these tests are given below:

- Type:** A test wall clad on the exterior face with Euroclad Linear 1 pressure equalising rainscreen façade system. As specified in the Parts List and drawings and shown in photographs in the annex to this report, the cross section of the test wall comprises;
1. Eight Linear 1 rainscreen panels at 4mm thick; various panel sizes with 'joints' on the exterior face of 18 to 20 mm width.
 2. One Window pod (blanked off for tests with a panel)
 3. One window sill detail of galvanised steel
 4. The panels above are hung on aluminium horizontal rails and vertical tracks. These are fixed to aluminium adjustable cleats that in turn fix back to the backing wall.
 5. The backing wall is a metal Metsec frame, 150 mm deep, with large (bottom) and small (top) parts divided horizontally by a steel 'I' section beam fixed to the test rig at either end.
 6. A 12 mm thick Pyroc cementitious board is fixed to the face of the Metsec frame nearest outdoors.
 7. On the outdoor face of the Pyroc board is a breather membrane. This is Monoflex plastic sheet with 150 mm overlaps where necessary fixed under the cleats described above.
 8. 50 mm thick Phenolic rigid insulation boards are fitted onto the outdoor face of the breather membrane.
 9. Between the outside face of the insulation and the indoor face of the rainscreen panels there is a gap of 87 mm.

Dimensions: Exterior surface of the Linear 1 rainscreen; 3960 mm high x 4000 mm wide (overall).
Area of outdoor face: approximately 15.84 m² (not allowing for joints)

4 Test rig and preparatory procedures

The specimen wall was constructed in BRE test rig 'B' and conditioned in the test laboratory for at least 4 hours within the temperature and humidity ranges of 10°C to 30°C and 25% to 75% RH respectively before testing commenced. The water temperature in the watertightness test was within the range 4°C to 30°C.

The specimen wall was mounted in the BRE test rig to form one wall of a pressure chamber with its outdoor face enclosed in the box. An array of spray nozzles was mounted in the pressure box to apply water to the outside face of the specimen at the rate of 2 L/m² per min in accordance with BS EN 12155.

Transducers were mounted on independent supports to measure deflections on the indoor face of the specimen wall. Deflections were measured on the span at the positions indicated in Figure 1.

5 Summary of test results

The test results are summarised in Table 1 below for a U.K exposure category of 2000 (Pa). Figures show detail of the specimen wall and detailed results are given in the Annex to this report.

BS ENs, Building regs, NHBC	Air permeability	
	Requirements	Results
BS EN 12152	1.5 m ³ /h.m ² at test pressures of 150 to 600 Pa	The backing wall (not curtain walling) does not meet the more stringent requirements set for curtain walling. 4.36 m ³ /h.m ² & 12.41 m ³ /h.m ² at 600 Pa under positive and negative test pressures respectively
Part L, Building regs	10 m ³ /h.m ² at 50 Pa	2.58 m ³ /h.m ² at 50 Pa, Meets and exceeds these requirements
NHBC	Rainscreen attached to a reasonably airtight backing wall	The backing wall was reasonably airtight (see full results in the Annex)

BS ENs, NHBC	Water tightness	
	Requirements	Results
BS EN 12154	Water tight to 750 pa	The test assembly was watertight up to and at 750 Pa test pressure. In BS EN 12154 for curtain walls this is Class RE750
NHBC	Gap behind rainscreen should be of sufficient width to allow any water passing the joints to run down the back of the rainscreen and drain away without wetting the insulation	The gap is 87 mm and provision for drainage is included in the design of the rainscreen

BS ENs,	Resistance to wind loads	
	Requirements	Results
BS EN 13116	Deflection not to exceed 1/200 of the span of a framing member. Recovery to a minimum of 95% of datum within 1 hour of loading	Maximum under -2000 pa was 6.63 mm, 1/404. Meets requirement Residual deflection recovered to within 95% of datum within 1 hour. Meets requirement
Repeat air permeability and water tightness	No significant increases or changes respectively	Met the requirements

Table 1. Summary of weathertightness test results

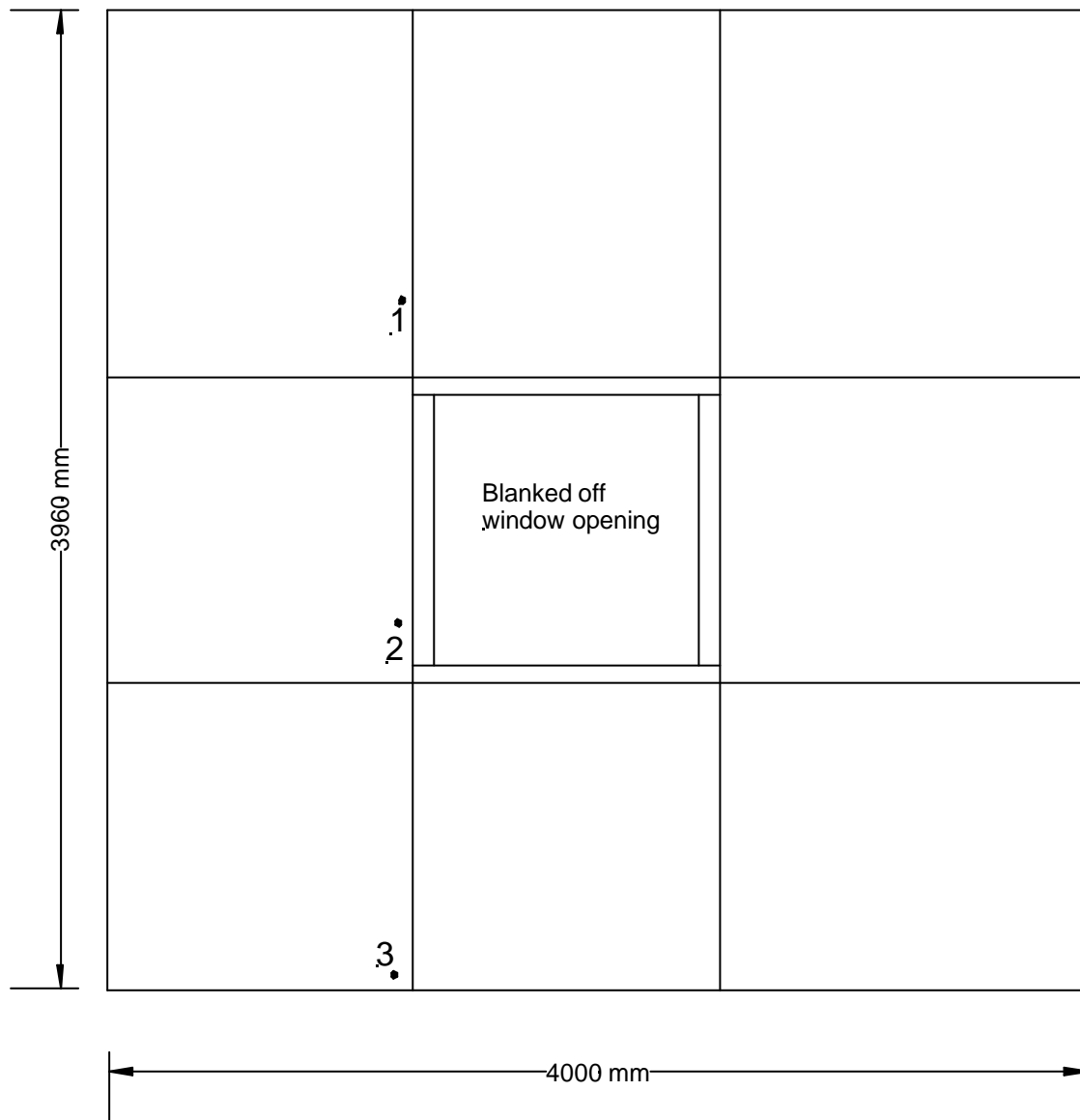
6 Conclusions

When the specimen Euroclad Façade Division test assembly incorporating Linear 1 pressure equalising rainscreen façade system was tested to the standards described herein it was found to be:

- Sufficiently airtight to meet the requirements of the Building Regulations and NHBC Standards under positive and negative test pressures.
- Resistant to water penetration up to and at 750 Pa test pressure so meeting the requirements of BS EN 12154: 1999 at class RE750.
- Resistant to design wind loads of ± 2000 Pa meeting the deflection, recovery and repeat air and water tightness requirements of BS EN 13116: 2001.

7 References

1. BS EN 12153: 2000. Curtain walling – Air permeability – Test method. British Standards Institution, London.
2. BS EN 12155: 2000. Curtain walling – Watertightness – Test method. British Standards Institution, London.
3. BS EN 12179: 2000. Curtain walling – Resistance to wind load – Test method. British Standards Institution, London.
4. CWCT Standard for systemised building envelopes: 2005. Centre for window and cladding technology.
5. BS EN 12152: 2002. Curtain walling – Air permeability – Performance requirements and classification. British Standards Institution, London.
6. BS EN 12154: 1999. Curtain walling – Watertightness - Performance requirements and classification. British Standards Institution, London.
7. BS EN 13116: 2001. Curtain walling – Resistance to wind load - Performance requirements and classification. British Standards Institution, London.
8. NHBC Standards Chapter 6.9 Curtain walling and cladding. 2005. National House Building Council.



Not to scale

Figure 1. Outline sketch of the outdoor face of the specimen wall showing positions of joints between rainscreen panels and window opening. Deflection measurement points, 1, 2 and 3, on the indoor face of a frame mullion on the Metsec metal frame

ANNEX Weathertightness test results

Air permeability test under positive air pressure

Pressure differential Pa	Air flow through the specimen m ³ /h	Air flow per unit area of the specimen m ³ /h.m ²
50	20.45	1.28
100	30.51	1.91
150	38.56	2.41
200	44.53	2.80
250	48.77	3.05
300	50.80	3.17
450	63.61	3.98
600	69.69	4.36

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

Air permeability test under negative air pressure

Pressure differential Pa	Air flow through the specimen m ³ /h	Air flow per unit area of the specimen m ³ /h.m ²
50	41.35	2.58
100	63.48	3.97
150	86.97	5.44
200	104.23	6.51
250	119.35	7.46
300	138.52	8.66
450	171.61	10.73
600	198.53	12.41

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

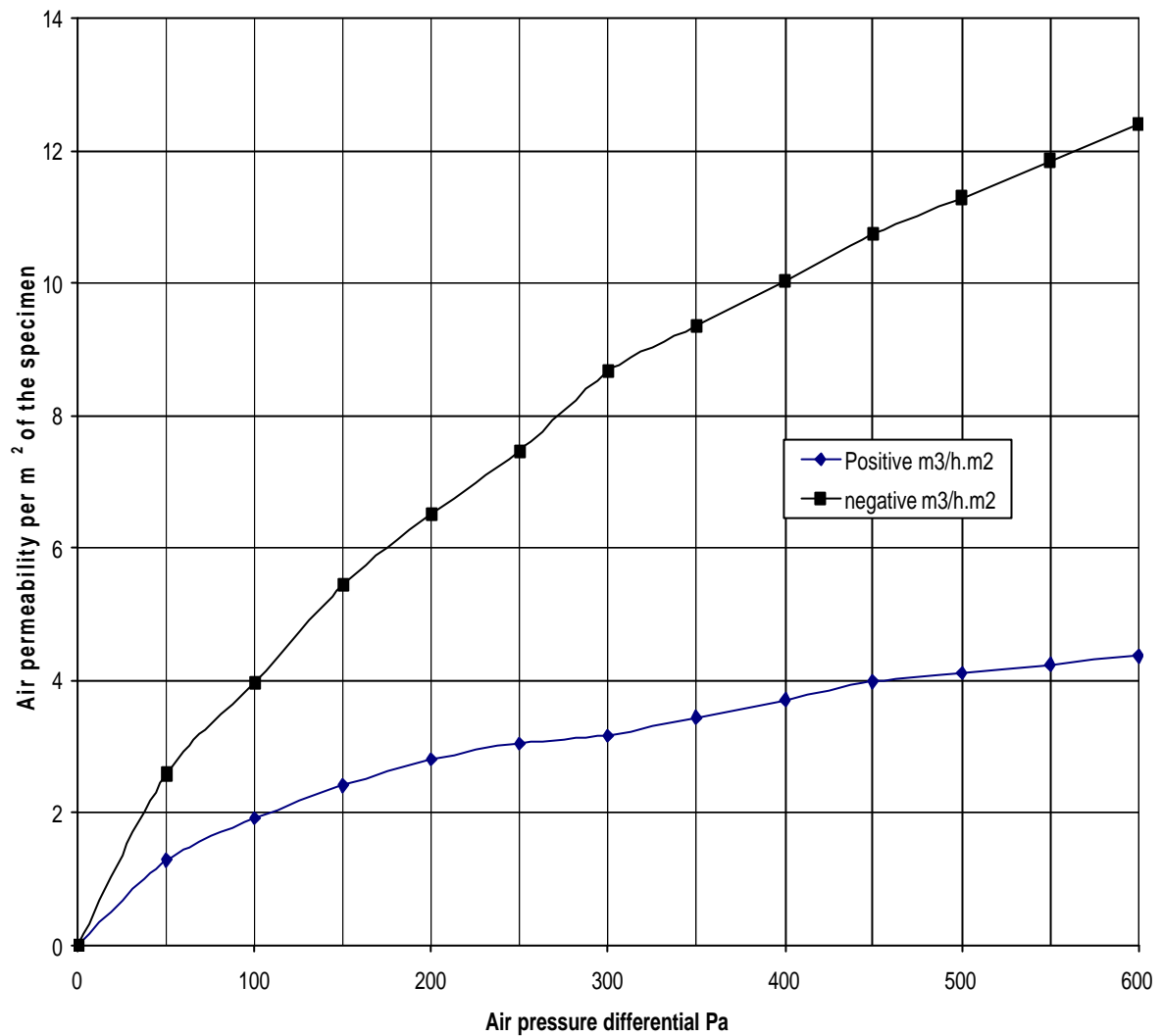


Figure A1. Air permeability under positive and negative air pressure; test results

Watertightness test

Pressure differential Pa	Duration Minutes	Water leaks
0	15	Nil
50	5	Nil
100	5	Nil
150	5	Nil
200	5	Nil
300	5	Nil
450	5	Nil
600	5	Nil
750	5	Nil

Test laboratory conditions: Air temperature 21.9°C. Test chamber air temperature 22.0°C
Air pressure 1014 mb. Relative humidity 49.5% at 21.9°C. Water temperature 18°C

Table A3. Watertightness test results

Resistance to wind load – Deflection test at ± 2000 Pa

Position deflection measured	Positive pressure P1 to +2000 Pa		Negative pressure P1 to -2000 Pa	
	Deflection		Deflection	
	mm	defl./span	mm	defl./span
Mid height of Metsec frame mullion (to right of window opening)	5.38	1/498	6.63	1/404
Residual deformation	Within an hour of the application of positive and negative design loads the frontal deflection had recovered to more than 95% of the starting position			

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 A4. Deflections measured on the indoor face of the specimen wall in the resistance to wind load test at ± 2000 Pa.

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

Pressure differential Pa	Air flow per unit area of the specimen $m^3/h.m^2$	Comparison to the air permeability measured previously (see Table A1)
50	1.28	The amounts of air flowing through the test specimen were not significantly different to those measured previously
100	1.96	
150	2.71	
200	2.70	
250	3.15	
300	3.23	
450	4.13	
600	4.51	

Table A5. 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 per unit area of the specimen $m^3/h.m^2$	Comparison to the air permeability measured previously (see Table A2)
50	2.63	The amounts of air flowing through the test specimen were not significantly different to those measured previously
100	4.07	
150	5.64	
200	6.67	
250	7.71	
300	8.91	
450	11.08	
600	12.61	

Table A6. Second air permeability test results under negative air pressures

Second watertightness test (part of resistance to wind load test)

Pressure differential Pa	Duration Minutes	Water leaks
0	15	Nil
50	5	Nil
100	5	Nil
150	5	Nil
200	5	Nil
300	5	Nil
450	5	Nil
600	5	Nil
750	5	Nil

Test laboratory conditions: Air temperature 22.8°C. Test chamber air temperature 23.0°C
Air pressure 1014 mb. Relative humidity 50.5% at 22.8°C. Water temperature 19°C

Table A7. Watertightness test results



Figure A2. The Metsec metal frame from the outdoor face; under construction



Figure A3. The outdoor face of the test specimen wall showing the Linear 1 rainscreen