

## TEST REPORT No. HO 07-07008 Assessment of the Airflex product

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REQUESTED BY:

KdB ISOLATION  
2 Avenue Lotz-Cossé  
BP 47506  
447275 Nantes Cedex 2

### **CENTRE SCIENTIFIQUE ET TECHNIQUE DU BATIMENT**

SIÈGE SOCIAL > 84 AVENUE JEAN JAURÈS | CHAMPS-SUR-MARNE | 77447 MARNE-LA-VALLÉE CEDEX 2

TÉL. (33) 01 64 68 82 82 | FAX. (33) 01 60 05 70 37 | SIRET 775 688 229 000 27 | [www.cstb.fr](http://www.cstb.fr)

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MARNE-LA-VALLÉE | PARIS | GRENOBLE | NANTES | SOPHIA-ANTIPOLIS

## SUBJECT

Assessment of an Airflex product as part of a request for a Technical Assessment.

## REFERENCE TEXTS

- NF EN 822: Thermal insulating products of building applications : Determination of length and width
- NF EN 823: Thermal insulating products of building applications : Determination of thickness
- NF EN 12 085: Thermal insulating products of building applications : Determination of linear dimensions of test specimens
- NF EN 1 602: Thermal insulating products of building applications : Determination of apparent density\*
- NF EN 1 608: Thermal insulating products of building applications : Determination of tensile strength parallel to faces
- NF EN 12 310-1: Thermal insulating products of building applications : Determination of resistance to tearing (nail shank).
- NF EN ISO 11339: T-peel test for flexible bonded assemblies
- NF EN 12 086: Thermal insulating products of building applications : Determination of water vapour transmission properties
- NF EN 12 667: Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Products of high and medium thermal resistance

Appendix B of the CUAP draft: Reflective products intended to be used in thermal insulation, proceeding of building shell

\* The apparent density is determined according to the principals of Standard EN 1 602 (weight by unit of volume or density). The same is true for the dimensions taking the field of application of these standards into account.

## ITEM SUBMITTED FOR TESTING:

- Description: Roof deck flexible radiating barrier
- Receipt date: March 21, 2007
- Origin: KdB ISOLATION
- Identification: E07 008
- Test date: July 2, 2007 to September 14, 2007

Made at Marne-la-Vallée, 8 February 2008

Technician responsible for the tests

Test Supervision

Didier LARZILLERE

Hafiane CHERKAOUI

## 1 - PURPOSE OF THE TESTS

On February 22, 2007, Société KdB ISOLATION ordered tests to determine the thermal and hydromechanical characteristics of a roof deck underlay membrane, designated Airflex. The test programme was carried out under the terms of a Technical Assessment request.

Test programme:

- Determining the mechanical performances:
  - Determination of resistance to tearing (initially and after ageing),
  - Determination of tensile strength parallel to the faces (initially and after ageing),
  - Determination of adhesive strength under parallel tension of the product (initially and after ageing),
  - Determination of adhesive strength under parallel tension of the adhesive tape (initially and after ageing),
  - Determination of adhesive strength under parallel tension of the adhesive incorporated in the product (initially and after ageing),
  - Determination of cohesive strength under perpendicular tension (initially and after ageing),
  - Determination of surface's peel-off resistance (initially and after ageing),
- Determination of thermal performances:
  - Core thermal resistance,
- Determination of water vapour transmission properties (permeability).

## 2 - DESCRIPTION OF THE TEST BODIES

The Airflex product is consists of:

- Two films, each composed of two layers of polyethylene,
- A central polyethylene foam,
- Two aluminium films, each consisting of three layers:
  - A protective cellulose lacquer,
  - The aluminium layer,
  - A polyethylene layer.

The main nominal characteristics of a roll are:

- Length: 25 000 mm
- Usable width: 1 200 mm
- Thickness: 10 mm
- Apparent density : 580 g/m<sup>2</sup>.

### 3 - IDENTIFICATION

The samples were shipped by the requester and received at the Marne la Vallée research station on March 21, 2007.

The length, the width and the apparent density of the samples, as well as of their components, were determined in compliance with Standards NF EN 822, NF EN 823 and NF EN 1602.

The results are given in Tables 1 and 2.

**Table 1: Dimensional and weight characteristics of the samples**

Sample reference	Production date	Weight in g	Length in mm	Width in mm	apparent density in g/m <sup>2</sup>
E07 008 – 1	14/03/07	3567.0	4850	1200	613
E07 008 – 2	01/03/07	3418.0	4882	1200	583
E07 008 – 3	23/01/07	3430.0	4800	1200	595
E07 008 – 4	01/02/07	2102.0	2950	1200	594
E07 008 – 5	09/03/07	3617.0	4890	1200	616
E07 008 – 6	06/02/07	3437.0	4836	1200	592
E07 008 – 7	14/02/07	3429.0	4820	1200	593
E07 008 – 8	19/02/07	3421.0	4830	1200	590
E07 008 – 9	15/01/07	3437.0	4850	1200	591
E07 008 – 10	27/02/07	17583	25000	1200	586

**Table 2: Dimensional and weight characteristics of the various components on sample E07 008 – 84**

	Nature of the material	Thickness in mm	apparent density measured in g/m <sup>2</sup>
1 <sup>st</sup> component	film + aluminium film	4.0	274
2 <sup>nd</sup> component	Polyethylene film	3.8	59
3 <sup>rd</sup> component	film + aluminium film	3.9	253

It is not possible to dissociate the aluminium films from the blister pack films.

## 4 - DETERMINING THE NAIL TEAR STRENGTH (INITIALLY AND AFTER AGEING)

### 4.1.1 - Test procedures.

The resistance to tearing (nail shank) is determined according to Standard NF EN 12 310. The fixed extremity of the test specimen is held in place by a self-tightening vise.

### 4.1.2 - Expressing the results.

The resistance to tearing is the maximal force recorded during the test.

### 4.1.3 - Preparing the test specimens.

Two series of five test specimens were prepared. One series was placed in an oven at 70°C and 90% RH during 60 days. The test specimens were stabilised in an ambiance of 23°C and 50% RH before the test.

### 4.1.4 - Results of the measurements.

The results of the measurements are given below:

**Table 3: Determining the nail tear strength**

Test specimen reference	Preparation	Thickness in mm	Apparente density in g/m <sup>2</sup>	Maximal force in N	Average maximal force in N
E07 008 I2	None	10.6	615	146	144
E07 008 I3		10.0	605	136	
E07 008 I4		10.1	615	150	
E07 008 I5		10.2	650	156	
E07 008 I6		10.4	640	134	
E07 008 V1	70°C / 90% RH during 28 days	10.8	625	129	140
E07 008 V2		10.6	625	138	
E07 008 V3		10.6	630	157	
E07 008 V4		10.5	640	140	
E07 008 V5		10.7	635	137	

## 5 - DETERMINING THE TENSILE STRENGTH PARALLEL TO THE FACES (INITIALLY AND AFTER AGEING)

### 5.1.1 - Test procedures.

The tensile strength is determined according to Standard NF EN 1 608. The test specimen is strained by two self-tightening vises during the tests.

### 5.1.2 - Expressing the results.

The parallel tensile strength is the maximal force recorded during the test. It is determined from the continuous recording of the force.

### 5.1.3 - Preparing the test specimens.

Two series of five test specimens were prepared. One series was placed in an oven at 70°C and 90% RH during 60 days. The test specimens were stabilised in an ambience of 23°C and 50% RH before the test.

### 5.1.4 - Results of the measurements.

**Table 4: Determining the parallel tensile strength**

Test specimen reference	Preparation	Thickness in mm	Width of the test zone in mm	Maximal force in N	Maximal strength in kPa	Average strength in kPa
E07 008 I8	None	11.5	64	289	394.28	413
E07 008 I9		11.0	62	294	429.25	
E07 008 I10		11.2	60	264	392.08	
E07 008 I11		10.8	61	253	385.82	
E07 008 I12		10.6	62	305	462.71	
E07 008 V8	70 °C / 90% RH during 28 days	10.3	62	286	450.45	425
E07 008 V9		10.8	63	295	432.54	
E07 008 V10		10.6	64	275	406.69	
E07 008 V11		11.8	62	299	407.26	
E07 008 V12		10.5	63	283	426.67	

## 6 - DETERMINING THE ADHESIVE STRENGTH UNDER PARALLEL TENSION OF THE PRODUCT (INITIALLY AND AFTER AGEING)

The purpose of this test is to characterise the quality of the adhesive incorporated in the product, the adhesive that provides waterproofing between two strips during the installation.

### 6.1.1 - Test procedures.

The adhesive strength is determined according to the test procedures of Standard NF EN 1 608. The test specimen is strained by two self-tightening vises during the test.

A test specimen is composed of two pieces of the product. The adhesive straddles the joint.

### 6.1.2 - Expressing the results.

The adhesive strength is the maximal force recorded during the test. It is determined from the continuous recording of the force.

### 6.1.3 - Preparing the test specimens.

Two series of five test specimens were prepared. One series was placed in an oven at 70°C and 90% RH during 28 days.

### 6.1.4 - Results of the measurements

**Table 5: Determining the adhesive strength under parallel tension**

Test specimen reference	Preparation	Thickness in mm	Width of the test zone in mm	Maximal force in N	Maximal strength in kPa	Average strength in kPa
E07 008 I14	None	14.6	64	163	174.34	174
E07 008 I15		14.5	62	159	176.93	
E07 008 I16		14.1	61	101	117.11	
E07 008 I17		16.1	62	164	163.98	
E07 008 I18		14.6	62	213	235.18	
E07 008 V14	70°C / 90% RH during 28 days	13.4	62	116	139.00	212
E07 008 V15		14.6	62	218	241.51	
E07 008 V16		14.1	60	177	209.21	
E07 008 V17		13.9	64	201	225.32	
E07 008 V18		13.6	63	211	245.75	

**For all the test specimens tested, break occurred at the product, but not at the adhesion between the adhesive and the product.**

## 7 - DETERMINING THE ADHESIVE STRENGTH UNDER PARALLEL TENSION OF THE ADHESIVE TAPE (INITIALLY AND AFTER AGEING)

The purpose of the test is to characterise the quality of the adhesive tape that provides the waterproofing between two strips during installation.

### 7.1.1 - Test procedures.

The adhesive strength is determined according to the test procedures of Standard NF EN 1 608. The test specimen is strained by two self-tightening vises during the test.

A test specimen is composed of two pieces of the product. The adhesive straddles the joint.

### 7.1.2 - Expressing the results.

The adhesive strength is the maximal force recorded during the test. It is determined from the continuous recording of the force.

### 7.1.3 - Preparing the test specimens.

Two series of five test specimens were prepared. One series was placed in an oven at 70°C and 90% RH during 28 days.

### 7.1.4 - Results of the measurements.

**Table 6: Determining the adhesive strength under parallel tension**

Test specimen reference	Preparation	Thickness in mm	Width of the test zone in mm	Maximal force in N	Maximal strength in kPa	Average strength in kPa
E07 008 I20	None	4.3	58	126	500.84	500
E07 008 I21		4.1	56	123	538.48	
E07 008 I22		4.0	62	121	486.20	
E07 008 I23		4.0	60	109	451.00	
E07 008 I24		4.1	63	136	521,96	
E07 008 V20	70°C / 90% RH during 28 days	4.3	61	116	446.77	479
E07 008 V21		4.0	61	123	498.05	
E07 008 V22		4.1	60	122	492.98	
E07 008 V23		4.2	60	126	495.55	
E07 008 V24		4.1	61	117	463.53	



## 8 - DETERMINING THE COHESIVE STRENGTH UNDER PERPENDICULAR TENSION (INITIALLY AND AFTER AGEING)

The purpose of the test is to characterise the quality of the cohesion between the blister pack film and the aluminium film.

### 8.1.1 - Test procedures.

A test specimen is composed of a piece of product, 300 mm x 25 mm, upon which the two films were separated over about 40 mm.

The cohesive strength under perpendicular tension is determined according to the test procedures of Standard NF EN ISO 11339. The test specimen is strained by two self-tightening vises during the test.

### 8.1.2 - Expressing the results.

The cohesive strength is the average force recorded during the test. It is determined from the continuous recording of the force over 100 mm.

### 8.1.3 - Preparing the test specimens.

Two series of five test specimens were prepared. One series was placed in an oven at 70°C and 90% RH during 28 days.

### 8.1.4 - Results of the measurements.

**Table 7: Determining the cohesive strength under perpendicular tension**

Test specimen reference	Preparation	Average force recorded in N	Average force in N
E07 008 I25	None	0.90	1.9
E07 008 I26		2.26	
E07 008 I27		0.85	
E07 008 I28		4.54	
E07 008 I29		1.12	
E07 008 V25	70°C / 90% RH during 28 days	1.15	1.9
E07 008 V26		0.97	
E07 008 V27		2.34	
E07 008 V28		1.27	
E07 008 V29		3.74	

## 9 - DETERMINING THE SURFACE'S PEEL-OFF RESISTANCE (INITIALLY AND AFTER AGEING)

The purpose of the test is to check the quality of the aluminised deposit of the outside facing by a visual inspection. The test specimens were taken at three different locations of the roll.

### 9.1.1 - Test procedures.

An adhesive is placed on a test specimen, 300 mm x 100 mm. After a contact of a few minutes, it is removed. The quality of the deposit is then displayed.

### 9.1.2 - Expressing the results.

Given the special character of the test, the quality of the deposit is judged to be satisfactory if the surface state of the test specimen remains unchanged.

### 9.1.3 - Preparing the test specimens.

Tow series of five test specimens were prepared. One series was placed in an oven at 70°C and 90% RH during 28 days.

The test specimens were stabilised in an ambiance of 23°C and 50% RH before the test.

### 9.1.4 - Results of the measurements.

**Table 8: Determining the surface's peel-off resistance**

Test specimen reference	Preparation	Surface state
E07 008 I30	None	Nothing to report
E07 008 I31		Nothing to report
E07 008 I32		Nothing to report
E07 008 I33		Nothing to report
E07 008 I34		Nothing to report
E07 008 V30	70°C / 90% RH during 28 days	Nothing to report
E07 008 V31		Nothing to report
E07 008 V32		Nothing to report
E07 008 V33		Nothing to report
E07 008 V34		Nothing to report

## 10 - DETERMINING THE WATER VAPOUR TRANSMISSION PROPERTIES (PERMEABILITY)

### 10.1.1 - Test procedures.

The tests were carried out in compliance with Standard NF EN 12086.

5 test specimens, diameter 110 mm, were cut out.

The tests were carried out in an ambience of  $23 \pm 2^\circ\text{C}$  and  $85 \pm 5\%$  RH.

### 10.1.2 - Identification of the tests specimens.

The linear dimensions and the apparent specific weight (density) of the test specimens were determined according to Standards EN 12085 and NF EN 1602. This is summarised in Table 9.

**Table 9: Dimensional and weight characteristics of the test specimens**

Test specimen reference	Diameter in mm	Weight in g	Apparent density in g/m <sup>2</sup>
E07 008 – 3	111.5	2.6	263
E07 008 – 4	112.0	2.6	268
E07 008 – 5	111.0	2.6	269
E07 008 – 6	112.0	2.4	247
E07 008 – 7	111.0	2.4	248

### 10.1.3 - Expressing the results

Permeability  $W$  of a test specimen is expressed by the relation:  $W = \frac{G}{A \cdot \Delta P}$  in  $\text{mg}/(\text{m}^2 \cdot \text{h} \cdot \text{Pa})$  where:

$G$  is the average of 5 successive measurements for each test specimen in mg per hour.

$\Delta P$  is the water vapour pressure difference in Pa, the magnitude of which is 2390 Pa for  $23 \pm 2^\circ\text{C}$  and  $85 \pm 5\%$  RH.

$A$  is the exposed surface area in  $\text{m}^2$ .

**10.1.4 - Results of the permeability measurements.**

Table 10 indicates, on the one hand, the increase in weight as a function of time, and on the other hand, the magnitude of the permeability to water vapour, obtained for each of the test specimens, as well as the average magnitude.

**Table 10: Results of the permeability tests**

Time in h	Weight increase in g				
	3	4	5	6	7
0	166.80	160.86	155.08	153.31	168.83
69	167.23	161.27	155.50	153.50	169.10
116	167.51	161.59	155.83	153.65	169.29
171	167.73	161.89	156.15	153.80	169.51
242	168.09	162.35	156.59	154.03	169.78
290	168.22	162.55	156.84	154.14	169.92
455	169.13	163.64	157.92	154.66	170.57
504	169.33	163.89	158.16	154.78	170.78
650	170.07	164.76	159.05	155.21	171.30
743	170.51	165.31	159.67	155.46	171.63
791	170.72	165.55	159.90	155.60	171.75

Permeability in mg/(m <sup>2</sup> .h.Pa)	0.256	0.309	0.320	0.149	0.186
Average permeability in mg/(m <sup>2</sup> .h.Pa)/h	0.0048	0.0058	0.0060	0.0028	0.0035
Standard deviation	0.256	0.309	0.320	0.149	0.186
Average permeability in mg/(m.h.Pa)	0.878				

## 11 - THERMAL RESISTANCE

Ten production dates were tested. The product's thermal resistance is determined by the flowmeter method. The test specimens are then constituted by stacking N elements.

### 11.1.1 - Dimensional and weight characteristics of the test specimens

The linear dimensions and the apparent density of the test specimens were determined in compliance with Standards NF EN 12 085 and NF EN 1 602.

The results of the measurements to determine the dimensional and weight characteristics are given in Table 11 below:

**Table 11: Dimensional and weight characteristics of the test specimens**

Test specimen reference	Production date	Number of elements N	Length l in mm	Width b in mm	Weight in g	Apparent density of an element in g/m <sup>2</sup>
E07 008 - 1	14/03/07	4	500	500	598.6	598.6
E07 008 - 2	01/03/07	4	500	500	583.9	583.9
E07 008 - 3	23/01/07	4	500	500	577.0	577.0
E07 008 - 4	01/02/07	4	500	500	578.1	578.1
E07 008 - 5	09/03/07	4	500	500	610.7	610.7
E07 008 - 6	06/02/07	4	500	500	582.3	582.3
E07 008 - 7	14/02/07	4	500	500	577.1	577.1
E07 008 - 8	19/02/07	4	500	500	585.4	585.4
E07 008 - 9	15/01/07	4	500	500	577.7	577.7
E07 008 - 10	27/02/07	4	500	500	615.3	615.3

**11.1.2 - Thermal results.**

The thermal resistance is determined according to the procedures of Standard NF EN 12 667.

The measurement results obtained are given in Table 12 below:

**Table 12: Results of the thermal measurements by the flowmeter method**

Test specimen reference	Production date	Number of element N	Thickness in test of N elements in mm	Thermal resistance of N elements at 10°C in m <sup>2</sup> .K/W	Thermal resistance of one element at 10°C in m <sup>2</sup> .K/W
E07 008 - 1	14/03/07	4	44.8	1.15	0.288
E07 008 - 2	01/03/07	4	44.1	1.18	0.295
E07 008 - 3	23/01/07	4	44.3	1.19	0.299
E07 008 - 4	01/02/07	4	44.2	1.17	0.292
E07 008 - 5	09/03/07	4	46.8	1.16	0.290
E07 008 - 6	06/02/07	4	44.3	1.17	0.292
E07 008 - 7	14/02/07	4	43	1.15	0.287
E07 008 - 8	19/02/07	4	44.6	1.14	0.285
E07 008 - 9	15/01/07	4	45.3	1.21	0.302
E07 008 - 10	27/02/07	4	42.9	1.13	0.281
E07 008 - 10 *		4	42.7	1.12	0.280

\* The internal faces of the test specimen were painted mat black.

**END OF REPORT**