


**ENVELOPE AND COVERINGS**  
Floor Covering and Roof Waterproofing

## TEST REPORT No. RSET 07-26006020 concerning the "AIRFLEX" roof deck underlay membrane

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**REQUESTED BY:**

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## **SUBJECT**

The purpose of the tests reported in this document is to determine certain characteristics of suitability for the application of the «AIRFLEX» roof deck underlay membrane.

## **REFERENCE TEXTS**

The tests were carried out according to:

- Standard NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements»

## **ITEMS SUBMITTED FOR TESTING**

Delivery date:	May 14, 2007	
Material:	Synthetic roof deck underlay membrane, heat insulation supplement.	
Trademark:	AIRFLEX	
Manufacturer:	KDB ISOLATION	Factory: /
Supplier:	KDB ISOLATION	

Tests carried out from May 23, 2007 to September 12, 2007.

Made at Marne-la-Vallée, September 19, 2007.

Technician  
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## 1 SAMPLING

Among the following tests, when the sampling method was not specified, the following method was used: the test specimens were taken within the roll, distributed regularly over the width of the roll, eliminating 15 cm along each longitudinal edge, and also eliminating the first and last meter of the roll.

## 2 PROCEDURE

### 2.1 WEIGHT PER UNIT OF SURFACE AREA AND THICKNESS



The tests were carried out according to Standards NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements» and NF EN 1849-2 « Determining the thickness and the weight per unit of surface area (plastic and elastomer waterproofing roofing membranes) ».

#### 2.1.1 Weight per unit of surface area

On the width of the roll, at 100 mm at least from the edges, 5 test specimens of 100 mm × 100 mm are taken and then weighed.

#### 2.1.2 Thickness

The thickness of the above test specimens were measured with the aid of a comparator at 0.001 mm, applying a measured pressure of 20 kPa using a piercer, 10 mm in diameter.

#### 2.1.3 Observations

Test date: Sept. 12, 2007	Dimensions		Weight (g)	Thickness (mm)	Weight/unit of surface area (g/m <sup>2</sup> )
	Measurement 1 (mm)	Measurement 2 (mm)			
Test speci. no. 07.21.1	102.0	100.0	6.063	9.9	594
Test speci. no. 07.21.2	102.0	100.0	5.888	10.2	577
Test speci. no. 07.21.3	102.0	102.0	6.034	10.1	580
Test speci. no. 07.21.4	102.0	100.0	5.668	10.0	556
Test speci. no. 07.21.5	100.0	100.0	6.059	10.1	606
Average	/	/	/	10.1	583

## **2.2 STRENGTH AND ELONGATION TO BREAK**



The tests were carried out according to Standards NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements » and NF EN 12311-1 « Bituminous waterproofing roof membranes – Determining the properties under tension ».

The purpose of these tests is to determine the properties under tension of the roof deck membrane both longitudinally and transversally.

### **2.2.1 Test specimens**

5 test specimens, taken in each direction, at more than 100 mm from the membrane's edges, dimensions 300 mm x 100 mm, were tested. Before the tests, they were doubled over, folding the two outside quarters of the test specimen toward the inside to obtain test specimens 300 mm x 50 mm.

### **2.2.2 Test method**

The test specimens were prepared during at least 20 h at  $(23 \pm 2)^{\circ}\text{C}$  and  $(50 \pm 20)\%$  RH.

The test specimens were subjected to the test of tensile stress to break, at a speed of  $(100 \pm 10)$  mm/min.

The maximal force of break and the corresponding elongation were measured for each test specimen. The tensile strength magnitude corresponds to 0.5 times the measured magnitude.

### 2.2.3 Observations

Conditions of the test: (23 ± 2)°C

	Longitudinal direction	
Test date: June 7, 2007	Maximal force (N/50 mm)	Elongation at the maximal force (%)
Test specimen no. 07.21.RTL1	161	29
Test specimen no. 07.21.RTL2	194	25
Test specimen no. 07.21.RTL3	220	30
Test specimen no. 07.21.RTL4	114	11
Test specimen no. 07.21.RTL5	200	32
Average	180	26
Standard deviation	41	9

	Transversal direction	
Test date: June 7, 2007	Maximal force (N/50 mm)	Elongation at the Maximal force (%)
Test specimen no. 07.21.RTT1	183	30
Test specimen no. 07.21.RTT2	150	28
Test specimen no. 07.21.RTT3	124	22
Test specimen no. 07.21.RTT4	155	22
Test specimen no. 07.21.RTT5	148	21
Average	150	25
Standard deviation	21	4

## 2.3 **NAIL TEAR STRENGTH TEST**

The tests were carried out according to Standard NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements» and NF EN 12310-1 « Bituminous waterproofing roof membranes – Determining the nail tear strength ».

### 2.3.1 Test specimens

5 test specimens, taken in each direction, at more than 100 mm from the edges of the membrane, dimensions 200 mm x 200 mm, were tested. Before the tests, they were doubled over, folding the two outside quarters of the test specimen toward the inside to obtain test specimens 200 mm x 100 mm. A nail, diameter 2.5 mm, penetrated the test specimen at 50 mm from the edge and fixed the test specimen to a clamp.

### 2.3.2 Test method

The test specimens were prepared during at least 20 h at  $(23 \pm 2)^{\circ}\text{C}$  and  $(50 \pm 20)\%$  RH. The test was carried out at a temperature of  $(23 \pm 2)^{\circ}\text{C}$ .

The maximal force at break at a speed of 100 mm/min was measured.

### 2.3.3 Observations

Longitudinal direction	
Test date: June 7, 2007	Maximal force (N)
Test speci. no. 07.21.RDL1	186
Test speci. no. 07.21.RDL2	136
Test speci. no. 07.21.RDL3	171
Test speci. no. 07.21.RDL4	181
Test speci. no. 07.21.RDL5	133
Average	160
Standard deviation	25

Transversal direction	
Test date: June 7, 2007	Maximal force (N)
Test speci. no. 07.21.RDT1	197
Test speci. no. 07.21.RDT2	197
Test speci. no. 07.21.RDT3	200
Test speci. no. 07.21.RDT4	142
Test speci. no. 07.21.RDT5	202
Average	190
Standard deviation	26



## 2.4 FLEXIBILITY AT LOW TEMPERATURE (FOLDABILITY WHEN COLD)

The tests were carried out according to Standards NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements» and Standard NF EN 1109 « Bituminous waterproofing roof membranes – Determining the flexibility at low temperature ».

The purpose of these tests is to determine the cracking behaviour by bending the roof deck membrane under the effect of cold.

### 2.4.1 Test specimens

The test specimens (50 mm x 140 mm), taken in the longitudinal direction at more than 100 mm from the edges of the roof deck membrane were tested at each temperature.

### 2.4.2 Test method

The cold folding was done on a mandrel, diameter 30 mm, at a speed of 360 mm/min. The cold folding temperature must be conducted as part of tests on a single test specimen, in increments of 6 °C, beginning at the planned cold folding temperature. Starting from the first temperature which led to cracking, the pinpointing tests were continued in increments of 2°C on series of five test specimens, for each face of the membrane, until four of the five test specimens of a single series, remained exempt from cracking, when winding them on the mandrel.

### 2.4.3 Observations

Test date July 5, 2007	Test specimen, longitudinal direction			
	Lower face		Upper face	
-36°C	07.21.PF1	No crack	07.21.PF6	No crack
	07.21.PF2	No crack	07.21.PF7	No crack
	07.21.PF3	No crack	07.21.PF8	No crack
	07.21.PF4	No crack	07.21.PF9	No crack
	07.21.PF5	No crack	07.21.PF10	No crack

The cold folding temperature of the roof deck membrane was:

Lower face: -36 °C

Upper face: -36 °C

Note: The minimal temperature generated by the test stand was -36°C.



### 3 SUITABILITY FOR THE APPLICATION

#### 3.1 **DETERMINING THE WATERTIGHTNESS**

The tests were carried out according to Standards NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements» and NF EN 1928 « Bituminous, plastic and elastomer roofing membranes – Determining the watertightness » (Method A).

The purpose of these tests is to determine the watertightness under pressure of the roof deck membrane.

##### 3.1.1 Test specimens

3 test specimens, diameter 200 mm, were tested.

##### 3.1.2 Test method

On the surface of the test specimen, a water pressure (200 mm of water) was applied during 2 hours. The watertightness was confirmed if no coloration was visible on the filter paper placed on the underface of the test specimen.

##### 3.1.3 Observations

Test conditions: (23 ± 2)°C

Test date: June 13, 2007	Watertight / not watertight
Test speci. no. 07.21.E1	Watertight
Test speci. no. 07.21.E2	Watertight
Test speci. no. 07.21.E3	Watertight

### **3.2 BEHAVIOUR UNDER STREAMING WATER**

The tests were carried out according to the specialised technical guide for flexible roof deck underlay membranes, accepted by Specialised Group no. 5 "Roofs" on February 24, 1992.

The purpose of these tests is to determine the watertightness of the roof deck membrane under streaming water.

#### **3.2.1 Test specimens**

3 test specimens, dimensions 1 x 1.2 m, were tested.

#### **3.2.2 Test method**

The membrane was positioned on the test stand at an angle of 30% from the horizontal. Three flat jet nozzles sprayed the water cyclically (at a flow rate of 0.5 l/min) at an angle of 30° from the membrane's surface. The streaming took place according to the width of the roll. The test specimen was subjected to five cycles of 30 minutes of continuous spraying and 30 minutes without spraying.

The test was carried out in such a way that the impact of the water jets was located at a junction between two membrane parts (junction made as described on the packing).

The watertightness was confirmed if no trace of dampness or droplets appears on the underface.

#### **3.2.3 Observations**

The three test specimens were watertight under streaming water.

### **3.3 WATER VAPOUR PERMEABILITY TESTS**

The tests were carried out according to Standards NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements» and NF EN 1931: «Determining the water vapour transmission properties (bituminous, plastic and elastomer roof waterproofing membranes)».

#### **3.3.1 Test specimens**

The membranes were prepared in compliance with the standard. At least 5 test specimens were prepared. Additional test specimens were prepared to palliate any shortcomings in the preparation. The product's thickness precluded using the test cups described in the standard so we used test cups with a larger rim but with a larger diameter.

So the tests were carried out on test specimens, the usable diameter of which was 101 mm instead of 80.1 mm. The necessary corrections were made in the calculations.

#### **3.3.2 Test method**

Sealed in test cups filled with drying agent, the test specimens were placed in a test ambience where the temperature and humidity were controlled:  $(23 \pm 1)^\circ\text{C}$  and  $(75 \pm 2)\%$  RH. The partial pressures inside the test cup and inside the enclosure generated a flow of water vapour across the test specimen. The apparatus was weighed weekly to determine the water vapour transmission coefficient.

The test was stopped when the measurement of the weight of the apparatus stayed within  $\pm 5\%$  during four successive measurements.

#### **3.3.3 Observations**

The stability of the weight measurement was reached only after 8 weeks of tests. So the tests were stopped. The results below correspond to the 4 most stable weeks of tests.

Test date: from July 20, 2007 to Sept. 6, 2007	d (m)	g (kg / (m <sup>2</sup> .s))	$\mu$	Sd (m)
Test speci. no. 07.21.1	1.1E-02	1.9E-09	2.0E+04	214
Test speci. no. 07.21.2	1.3E-02	1.2E-09	2.7E+04	354
Test speci. no. 07.21.3	1.2E-02	1.7E-09	2.0E+04	243
Test speci. no. 07.21.5	1,1E-02	1.2E-09	3.1E+04	335
Test speci. no. 07.21.6	1.1E-02	1.1E-09	3.4E+04	376
Average	1.2E-02	1.4E-09	2.6E+04	304

d: Thickness of the test specimen

g: Density of the water flow

$\mu$ : Water resistance factor

Sd: Thickness of the air layer equivalent to the diffusion of the water vapour

### 3.4 DETERMINING THE DIMENSIONAL STABILITY

The tests were carried out according to Standards NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements» and procedure B of Standard NF EN 1107-2 « Plastic and elastomer roof waterproofing membranes – determining the dimensional stability ».

The purpose of these tests is to determine the residual deformation at 23°C after stabilisation of the dimensions at 80 ± 2°C during 6 h ± 15 min.

#### 3.4.1 Test specimens

3 test specimens, dimensions 250 mm × 250 mm, were prepared. Markers, making it possible to measure to within 0.1 mm, the dimensional variations of the test specimen, were fixed on their upper faces in the longitudinal and transversal directions of the membrane.

#### 3.4.2 Test method

The test specimens' dimensions were measured at the initial state at 23°C.

The test specimens were placed in an enclosure at 80°C during 6 hours. Once the test specimen was cooled naturally at 23°C, the dimensions were measured again. Shrinkage is indicated by a negative number and expansion by a positive number (without sign).

Test conditions: (23 ± 2)°C.

#### 3.4.3 Observations

	Longitudinal direction			Transversal direction		
	Length before oven treatment (mm)	Length after oven treatment (mm)	Dimensional variation (%)	Length before oven treatment (mm)	Length after oven treatment (mm)	Dimensional variation (%)
Test date: June 7, 2007						
Test speci. no. 07.21.1	200.6	200.5	0.0	200.7	200.8	0.0
Test speci. no. 07.21.2	200.5	200.4	0.0	201.2	201.5	0.1
Test speci. no. 07.21.3	200.3	200.0	-0.1	200.4	200.2	-0.1
Average			-0.1			0.0

The shrinkage is indicated by the – sign and expansion by the + sign

## 4 DURABILITY

### 4.1 AGEING

The samples were aged according to Standard NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements» and Standards NF EN 1296 and EN 1297.

Ageing characteristics:

- 336 hours under continuous UV radiation (340 nm) of 45 W/m<sup>2</sup>, without sprinkling, at a temperature of 50°C.
- 90 days in oven at 70°C, in vertical position.

The test specimens were then cut out from the aged samples.

### 4.2 **STRENGTH AND ELONGATION TO BREAK** **AFTER AGEING**

The tests were carried out according to Standards NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements» and NF EN 12311-1 «Bituminous waterproofing roof membranes – Determining the properties under tension ».

The purpose of these tests was to determine the tensile strength of the roof deck membrane in the longitudinal direction and in the transversal direction after ageing.

#### 4.2.1 Test specimens

5 test specimens, taken within each direction, at more than 100 mm from the edges of the membrane, dimensions 300 mm x 100 mm, were tested. Before the test, they were doubled over by folding the two outside quarters of the test specimens toward the inside to obtain test specimens 300 mm x 50 mm.

#### 4.2.2 Test method

The test specimens were prepared during at least 20 h at (23 ± 2)°C and (50 ± 20)% RH.

The test specimens were subjected to the test of tensile stress to break, at a speed of (100 ± 10) mm/min.

The maximal force at break and the corresponding elongation were measured for each test specimen.

The tensile strength value corresponds to 0.5 times the measured value.

**4.2.3 Observations**

Test conditions: (23 ± 2)°C

	<b>Longitudinal direction</b>	
Test date: Sept. 11, 2007	Maximal force (N/50 mm)	Elongation at the maximal force (%)
Test speci. no. 07.21.RTLV1	212	27
Test speci. no. 07.21.RTLV2	202	33
Test speci. no. 07.21.RTLV3	212	28
Test speci. no. 07.21.RTLV4	208	38
Test speci. no. 07.21.RTLV5	208	34
<b>Average</b>	210	32
<b>Standard deviation</b>	4	4

	<b>Transversal direction</b>	
Test date: Sept. 11, 2007	Maximal force (N/50 mm)	Elongation at the Maximal force (%)
Test speci. no. 07.21.RTTV1	229	34
Test speci. no. 07.21.RTTV2	213	31
Test speci. no. 07.21.RTTV3	222	30
Test speci. no. 07.21.RTTV4	218	29
Test speci. no. 07.21.RTTV5	227	26
<b>Average</b>	220	30
<b>Standard deviation</b>	7	3

**4.3 DETERMINING THE WATERTIGHTNESS  AFTER AGEING**

The tests were carried out according to Standards NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements» and NF EN 1928 « Bituminous, plastic and elastomer roofing membranes – Determining the watertightness » (Method A).

The purpose of these tests is to determine the watertightness under pressure of the roof deck membrane, after ageing.

**4.3.1 Test specimens**

3 test specimens, diameter 200 mm, were tested.

**4.3.2 Test method**

On the surface of the test specimens, a water pressure (200 mm of water) was applied during 2 hours. The watertightness was confirmed if no coloration of the filter paper placed on the underface of the test specimens was visible.

**4.3.3 Observations**

Test conditions: (23 ± 2)°C

**4.4 DETERMINING THE RESISTANCE TO WATER PENETRATION AFTER AGEING**

The tests were carried out according to Standards NF EN 13859-1 «Flexible waterproofing membranes – Roof deck flexible underlay membranes for roofing in small discontinuous elements» and NF EN 13111 « Roof deck membranes and rain barriers for walls – Determining the water penetration resistance ».

The purpose of these tests is to determine the water penetration characteristics of the roof deck membrane after ageing.

**4.4.1 Test specimens**

3 test specimens, 400 x 250 mm, were tested.

**4.4.2 Test method**

On the surface of the test specimens, a volume of 2.25 litres of water was applied during 3 hours ± 5 min. The quantity of water that penetrated the test specimens was then determined by weighing.

**4.4.3 Observations**

Test conditions: (23 ± 2)°C

Test date: Sept. 12, 2007	Watertight / Not watertight
Test speci. no. 07.21.EV.1	Watertight
Test speci. no. 07.21.EV.2	Watertight
Test speci. no. 07.21.EV.3	Watertight

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**END OF REPORT**

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