

**TNO report**

**2006-CVB-R0395**

Examination on reaction to fire and smoke  
production according to EN-ISO 11925-2: 2002  
and EN-ISO 9239-1: 2002 of Forbo Marmoleum/  
Artoleum 2.0 mm and 3.2 mm floor covering,  
glued on particle board

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Date	July 2006
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Project name	Reaction to fire of floorings
Project number	006.55489/01.01
Number of pages	6
Number of graphs	1
Number of photos	1

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**Subject:**

**Forbo Marmoleum/Artoleum 2.0 mm and 3.2 mm** floor covering, glued on 18 mm particle board.

**Purpose of tests:**

Determination of the reaction to fire and smoke production according to the examination methods of EN ISO 11925-2: 2002- 'Ignitability' and EN- ISO 9239-1: 2002 - 'Radiant panel test for floor coverings'.

**Contractor:**

Forbo Flooring B.V.  
P.O. Box 13  
NL-1560 AA KROMMENIE  
The Netherlands

**Period of examination:**

January - April 2006.

**Period of issue and report number:**

July 2006; **2006-CVB-R0395**.

**Description of the material:**

*Composition:*

According to the manufacturer the **Marmoleum/Artoleum** floor covering product is produced in accordance with EN 548 in a thickness range of **2.0 mm** to **3.2 mm**.

It is based on a one- or a two-layer homogeneous mixture of linoleum cement, wood flour, limestone and pigments, applied on a fibrous backing.

For the product with a nominal overall thickness of 2.0 mm, the surface layer has a minimum thickness of 0.8 mm and for the products with a nominal overall thickness of 2.5 to 3.2 mm the minimum surface layer thickness is 1.3 mm.

Linoleum cement is consisting of a mixture of linseed oil and/or other vegetable drying oils and rosin.

*Dimensions and mass per unit area:*

Nominal overall thickness: 2.0 to 3.2 mm.

Mass per unit area: approx. 2.3 to 4.0 kg/m<sup>2</sup>.

**Sample:**

*Sampling:*

On November 30, 2005 a number of **Marmoleum/Artoleum** floor covering specimens with a thickness of 2.0 mm and 3.2 mm were received from the contractor. The floor coverings had been glued on 18 mm particle board by the contractor with a prescribed standard linoleum adhesive.

*Age:*

No information received. At the time of examination: 5 weeks.

*Conditioning:*

Prior to the examinations the specimens were conditioned for approx. 5 weeks at 23 ± 2 °C and 50 ± 5 % relative humidity according to § 4.1 of EN 13238: 2001.

**Method of examinations:**

The examination on flammability and horizontal fire propagation of floor coverings were carried out according to the EN ISO 11925-2: 2002 and the EN-ISO 9239-2: 2002.

The flammability examination was carried out completely on the 2.0 mm thick and additionally on the 3.2 mm thick product combination with surface ignition with a flame application time of 15 seconds.

With the reaction to fire examination on each product thickness initially two tests were carried out in each direction of the products; one on a specimen cut in the production direction and one cut perpendicular to the production direction. Based on the test results found, the examination was continued in that direction and thickness of the type with the less positive result with two additional tests.

The specimens were examined in combination with a prescribed non-FR particle board substrate (EN 312-2 -  $680 \pm 50 \text{ kg/m}^3$  -  $20 \pm 2 \text{ mm}$ ) according to § 5.1.3 of EN 13238: 2001.

**Test results of (A) the flammability according to EN-ISO 11925-2 and (B) the reaction to fire according to EN-ISO 9239-1: 2002 of Forbo Marmoleum/Artoleum floor covering with a thickness of 2.0 mm and 3.2 mm, glued on 18 mm particle board.**

*A - Ignitability – EN-ISO 11925-2 – Surface ignition - flame application time 15 s.*

Test	Ignition of sample	Maximum flame height	t <sub>150</sub>	Afterburning time	Ignition of filter paper
	[Y/N]	[mm]	[s]	[s]	Y/N
<b>Thickness 3.2 mm</b>					
1	Y	20	∞ not reached	0	N
2	Y	25			
3	Y	25			
<b>Thickness 2.0 mm</b>					
1	Y	30	∞ (6 x) not reached	0	N
2	Y	35		0	N
3	Y	32		0	N
4	Y	25		0	N
5	Y	30		0	N
6	Y	30		0	N
<b>Value used for classification</b>		<b>30</b>	<b>Not reached</b>	<b>0</b>	<b>N</b>

*Remark:* As within EN-ISO 11925-2: 2002 material is tested in a vertical position the “Edge ignition” is respected not to be relevant for floor coverings, when used in horizontal application(s).

The **Forbo Marmoleum/Artoleum** floor covering / 18 mm particle board substrate combination with thickness of **2.0 mm** and **3.2 mm** complies with the flammability criteria of the Euroclass E<sub>n</sub> according to EN 13501-1: 2002.

**Forbo Marmoleum/Artoleum** floor covering with a thickness of **2.0 mm** and **3.2 mm**, glued on 18 mm particle board.

B - Horizontal surface flame spread – EN 9239-1:2002.

Product Direction (*) and product thickness	Test no.	Time of reaching "50 mm" marks		Maximum flame travel		Critical heat flux	Smoke density	
		mm	mins.	distance	time	(CHF)	%min	
				m	mins.	kW/m <sup>2</sup>		
Production <b>3.2 mm</b>	1	50	3 <sup>3</sup> / <sub>4</sub>	0.30	11 <sup>3</sup> / <sub>4</sub>	7.2	304	
		100	5					
		150	6 <sup>1</sup> / <sub>4</sub>					
		200	6 <sup>1</sup> / <sub>2</sub>					
		250	7 <sup>3</sup> / <sub>4</sub>					
		300	11 <sup>3</sup> / <sub>4</sub>					
Production <b>2.0 mm</b>	1	50	3 <sup>1</sup> / <sub>8</sub>	0.34	18 <sup>3</sup> / <sub>4</sub>	6.3	226	
		100	4					
		150	5					
		200	6 <sup>1</sup> / <sub>2</sub>					
		250	10					
		300	12 <sup>1</sup> / <sub>4</sub>					
Cross <b>2.0 mm</b>	2	50	3 <sup>1</sup> / <sub>4</sub>	0.38	20	5.5	261	
		100	5					
		150	6 <sup>1</sup> / <sub>2</sub>					
		200	8					
		250	10 <sup>1</sup> / <sub>8</sub>					
		300	13 <sup>1</sup> / <sub>4</sub>					
	3	3	50	3 <sup>3</sup> / <sub>4</sub>	0.40	29 <sup>3</sup> / <sub>4</sub>	5.0	242
			100	4 <sup>3</sup> / <sub>4</sub>				
			150	6 <sup>1</sup> / <sub>8</sub>				
			200	7 <sup>1</sup> / <sub>2</sub>				
			250	9 <sup>3</sup> / <sub>4</sub>				
			300	13				
4	4	50	3 <sup>1</sup> / <sub>2</sub>	0.34	17 <sup>3</sup> / <sub>4</sub>	6.3	226	
		100	4 <sup>1</sup> / <sub>2</sub>					
		150	5 <sup>3</sup> / <sub>4</sub>					
		200	7 <sup>3</sup> / <sub>4</sub>					
		250	9 <sup>3</sup> / <sub>4</sub>					
		300	13 <sup>3</sup> / <sub>4</sub>					
<b>Average values</b>		-	-	<b>0.37</b>	<b>22<sup>1</sup>/<sub>2</sub></b>	<b>5.6</b>	<b>243</b>	

(\*) Production = specimens cut in the production direction of the floor covering. The tests indicated with Cross, the specimens had been cut perpendicular to the production direction. Due to the less positive result that was found in the Cross direction the examination was carried out completely in this direction on which the average values over the three test results were determined.

Observations during tests: No specific or odd events were observed.

Heat flux (HF) values at xx minutes	Test no. of	HF-10	HF-20	HF-30
kW/m <sup>2</sup>	<b>3.2 mm</b> thick product			
	1 – Prod.	7.6	-	-
	<b>2.0 mm</b> thick product			
	1 – Prod.	8.3	-	-
	1 – Cross	8.5	5.4	-
	2 – Cross	8.1	5.9	5.0
	3 – Cross	8.1	-	-

**Assessment:**

Based on the test results the examined **Forbo Marmoleum/Artoleum** linoleum floor covering product, with a nominal thickness range of **2.0 mm** to **3.2 mm** and a mass per unit area range of 2.3 to 4.0 kg/m<sup>2</sup>, glued on a 18 mm thick particle board, fulfilled the criteria that have been given for Euroclass C<sub>fl</sub>-s1 (requirements: *Meet the flammability criteria of Euroclass E<sub>fl</sub> and have a Critical Heat Flux (CHF) ≥ 4.5 and ≤ 8.0 kW/m<sup>2</sup> and a smoke production of ≤ 750 % minutes*) according to EN 13501-1: 2002).

A formal classification report according to EN 13501-1: 2002 will be issued separately.

**Remark 1:**

The results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

They are valid for the use on a wooden substrate or sub floor which is at least comparable to the examined one (EN 312-2 – 680 ± 50 kg/m<sup>3</sup>) and also in combination with non-combustible substrates (ISO 390 - 1800 ± 200 kg/m<sup>3</sup> – 6 ± 1 mm ) according to respectively § 5.1.3 and 5.1.2 of EN 13238: 2001.

**Remark 2:**

The uncertainty of measurement of reaction to fire tests is an item under discussion within TC4 of EGOLF.

Pending the outcome of this process, we will not give an expression of the uncertainty of measurement of the results presented in this report.



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Dr. F. Paap

**Graph of the Critical Heat Flux (CHF) and photograph after examination according to EN ISO 9239-1: 2002 of Forbo Marmoleum/Artoleum floor covering – nom. thickness 2.0 mm, glued on 18 mm particle board.**

