

Test report n° SC-2020-018

concerning the 100% 6.6 NYLON (SBR Latex) carpet

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APPLICANT / MANUFACTURER :

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OBJECTIVE

The purpose of this test is to characterize volatile organic compounds (VOC) and formaldehyde emissions from a carpet after 28 days according to ISO 16000 standards and to check the compliance of emissions with requirements of the mandatory requirements in France:

- ✓ VOC emission class according to French labelling system (Decree n° 2011-321 of March 23, 2011 and Order of April 19, 2011 modified by Order of February 20, 2012),
- ✓ absence of release of CMR compounds (Orders of April 30, 2009 and May 28, 2009).

According to CSTB quotation n° 26085178

REFERENCES

- EN ISO 16000-9 : Indoor air – Part 9 : Determination of the emission of volatile organic compounds from building products and furnishing – Emission test chamber method (ISO, 2006).
- EN ISO 16000-11 : Indoor air – Part 11 : Determination of the emission of volatile organic compounds from building products and furnishing – Sampling, storage of samples and preparation of test specimen (ISO, 2006).
- ISO 16000-6 : Indoor air – Part 6 : Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS or MS-FID (ISO, 2011).
- ISO 16000-3 : Indoor air – Part 3 : Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air – Active sampling method (ISO, 2011).

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DESCRIPTION OF TEST SAMPLES

This test report is concerning the 100% 6.6 NYLON (SBR Latex) carpet (production date: 16.01.2020) from the TAI PING Carpets Company.

Tested sample	Laboratory reference	Reception of sample	Start of testing		End of testing
			Test specimen preparation	Introduction in test chamber	
100% 6.6 NYLON (SBR Latex)	POL-20-10	20/01/2020	23/01/2020 ; 13:00	23/01/2020 ; 13:30	20/02/2020 ; 10:48

Table 1 : Description of test samples

PREPARATION OF TEST SPECIMEN

TAI PING provided CSTB with four precut carpet pieces (dimensions: 0.50 m x 0.15 m). The test specimen has been prepared by selecting one piece and covering back and edges with a stainless-steel plate and low emission adhesive (Figure 1). The effective emitting surface of the test specimen is 0.058 m² (0.460 m x 0.126 m). Just after preparation, the test specimen has been placed on a stainless-steel stand and introduced in an emission test chamber.



Figure 1 : Test specimen of the 100% 6.6 NYLON (SBR Latex) carpet

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EMISSION TEST CHAMBER CONDITIONS

Just after preparation, test specimens were introduced in a glass emission test chamber according to requirements of EN ISO 16000-9 standard. Testing parameters are presented in Table 2.

Test parameters	Test chamber conditions
Emission test chamber type	CLIMPAQ (glass)
Emission test chamber volume	0.0509 m ³
Temperature	23.7 ± 1.3 °C
Relative humidity	51.6 ± 1.8 %
Test specimen surface	0.058 m ²
Air flow rate	0.075 m ³ /h
Air exchange rate	1.47 h ⁻¹
Product loading factor	1.14 m ² /m ³
Area specific air flow rate (q _{test})	1.29 m ³ /m ² .h
Test duration	28 days

Table 2 : Testing conditions

VOC AND FORMALDEHYDE SAMPLING CONDITIONS

VOC and aldehyde (ALD) active sampling were performed in duplicate by pumping air through respective sorbents just before beginning of the test (day 0) and 28 ± 2 days (day 28) after introduction of the test specimen in the emission test chamber. Sampling conditions are presented in Table 3.

Sampling conditions	VOC	VOC	ALD
Number of sampled tubes	1	1	1
Sorbent type	Tenax TA	Tenax TA	DNPH
Sampling duration	60 min.	60 min.	60 min.
Sampling air flow rate	100 mL/min	75 mL/min	600 mL/min
Sampled air volume	6.0 L	4.5 L	36.0 L

Table 3 : Sampling conditions

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VOC AND ALD SAMPLING AND MEASUREMENT METHODS

Sampling and measurements of VOC are performed according to ISO 16000-6. Parameters selected for VOC analyses at CSTB are presented in Table 4.

Analytical equipments used for VOC analyses are :

- Perkin Elmer Turbomatrix 350 automatic thermo desorption (ATD) unit coupled to a Perkin Elmer Autosystem XL gas chromatograph (GC), with a flame ionization detector (FID) Perkin Elmer TurboMass mass spectrometer (MS).
- Perkin Elmer Turbomatrix 650 automatic thermo desorption (ATD) unit coupled to a Perkin Elmer Clarus 580 gas chromatograph (GC), with a flame ionization detector (FID) Perkin Elmer Clarus SQ8S mass spectrometer (MS).

Parameters	Analytical conditions
Desorption temperature	280 °C
Nitrogen flow rate	50 mL/min
Desorption duration	20 min
Secondary trap temperature	280 °C
Temperature cycle	40 °C during 5 min. 2.5 °C/min. up to 170 °C 7.5 °C/min. up to 300 °C 300 °C during 26 min.
Capillary column	Capillary column (Elite ou VF 5 ms) length : 60 m, internal diameter : 0.25 mm, phase thickness : 1 µm
FID temperature	270 °C
Mass spectrometer parameters	70 eV 33-450 amu

Table 4 : Analytical conditions for VOC analyses

VOC are identified by mass spectrometry (MS) and quantified by MS or flame ionization detector (FID) using their specific response factor when available (specific calibration) or using the toluene response factor (concentrations expressed in toluene equivalent).

The total VOC concentration (TVOC) is calculated as the sum of concentrations of all volatile organic compounds eluting between n-hexane and n-hexadecane (included) quantified using the toluene response factor. The TVOC concentration is expressed in toluene equivalent.

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Sampling and measurements of formaldehyde and other carbonyl compounds (ALD) are performed according to ISO 16000-3. Parameters for their analysis at CSTB are presented in Table 5.

Sampling is performed by pumping on cartridges filled with silica gel coated with 2,4-dinitrophenylhydrazine (DNPH). After sampling, cartridges are eluted in 5 ml acetonitrile. Two 20 µl injections of this elution solution are analyzed by high performance liquid chromatography (HPLC) on a WATERS Alliance system.

Aldehydes are identified and quantified using specific calibration.

Parameters	Analytical conditions
Detector	UV or Photodiode (wave length : 360 nm)
Capillary column	WATERS Novapack C18 length : 150 mm internal diameter : 3.9 mm phase thickness : 4 µm pore diameter : 60 Å
Elution flow rate	1.5 mL/min
Column temperature	35 °C

Table 5 : Analytical conditions for formaldehyde and other carbonyl compounds analyses

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TEST RESULTS

Test results presented in this report are the arithmetic means of the 2 sampled and analysed samples. Results are corrected from the chamber blank value measured before introduction of the test specimen in the emission test chamber.

Test results are expressed as area specific emission rates (SER_a , in $\mu\text{g}/\text{m}^2\cdot\text{h}$), calculated according to EN ISO 16000-9 as:

$$SER_a = C_{\text{meas}} \cdot q_{\text{test}}$$

where C_{meas} are the measured concentrations ($\mu\text{g}/\text{m}^3$) and q_{test} the area specific air flow rate during testing (Table 2).

SER_a = Area specific emission rates ($\mu\text{g}/\text{m}^2\cdot\text{h}$)			
Compounds	N° CAS	28 days	Calibration
VOC (ISO 16000-6)			
benzene	71-43-2	<LQ	specific
trichloroethylene	79-01-6	0,7	specific
dibutyl phthalate	84-74-2	0,3	specific
bis(2-ethylhexyl) phthalate	117-81-7	1,0	specific
toluene	108-88-3	<LQ	specific
tetrachloroethylene	127-18-4	<LD	specific
ethylbenzene	100-41-4	<LQ	specific
m-xylene	108-38-3	<LQ	specific
p-xylene	106-42-3	<LQ	specific
styrene	100-42-5	<LQ	specific
o-xylene	95-47-6	<LQ	specific
2-butoxyethanol	111-76-2	0,4	specific
1,2,4-trimethylbenzene	95-63-6	<LQ	specific
1,4-dichlorobenzene	106-46-7	<LD	specific
TVOC	-	57,9	toluene equivalent
ALD (ISO 16000-3)			
formaldehyde	50-00-0	<LQ	specific
acetaldehyde	75-07-0	<LQ	specific

Table 6 : VOC and ALD area specific emission rates ($\mu\text{g}/\text{m}^2\cdot\text{h}$)
from the 100% 6.6 NYLON (SBR Latex) carpet (LD : detection limit, LQ : quantification limit)

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EVALUATION OF VOC AND ALD EMISSIONS

For the evaluation of VOC and formaldehyde emissions from building products, exposure concentrations are calculated from area specific emission rates as:

$$C_{\text{exp}} = \text{SER}_a / q_{\text{scenario}}$$

Where C_{exp} are the calculated exposure concentrations ($\mu\text{g}/\text{m}^3$) in the reference room defined in the Order of April 19, 2011, SER_a are the area specific emission rates ($\mu\text{g}/\text{m}^2.\text{h}$) and q_{scenario} the area specific air flow rate for the selected emission scenario (for this test, "floor" scenario: $q_{\text{scenario}} = 1.25 \text{ m}^3/\text{m}^2.\text{h}$).

Cexp = Exposure concentrations ($\mu\text{g}/\text{m}^3$)			
Compounds	N° CAS	28 days	Calibration
VOC (ISO 16000-6)			
benzene	71-43-2	<LQ	specific
trichloroethylene	79-01-6	0,6	specific
dibutyl phthalate	84-74-2	0,2	specific
bis(2-ethylhexyl) phthalate	117-81-7	0,8	specific
toluene	108-88-3	<LQ	specific
tetrachloroethylene	127-18-4	<LD	specific
ethylbenzene	100-41-4	<LQ	specific
m-xylene	108-38-3	<LQ	specific
p-xylene	106-42-3	<LQ	specific
styrene	100-42-5	<LQ	specific
o-xylene	95-47-6	<LQ	specific
2-butoxyethanol	111-76-2	0,3	specific
1,2,4-trimethylbenzene	95-63-6	<LQ	specific
1,4-dichlorobenzene	106-46-7	<LD	specific
TVOC	-	46,3	toluene equivalent
ALD (ISO 16000-3)			
formaldehyde	50-00-0	<LQ	specific
acetaldehyde	75-07-0	<LQ	specific

Table 7 : VOC and ALD exposure concentrations ($\mu\text{g}/\text{m}^3$)
from the 100% 6.6 NYLON (SBR Latex) carpet (LD : detection limit, LQ : quantification limit)

VOC EMISSION CLASS ACCORDING TO THE FRENCH LABELLING SYSTEM

Compounds	CAS number	emission classes			
		C	B	A	A+
formaldehyde	50-00-0	> 120	< 120	< 60	< 10
acetaldehyde	75-07-0	> 400	< 400	< 300	< 200
toluene	108-88-3	> 600	< 600	< 450	< 300
tetrachlorethylene	127-18-4	> 500	< 500	< 350	< 250
xylene	1330-20-7	> 400	< 400	< 300	< 200
1,2,4-trimethylbenzene	95-63-6	> 2000	< 2000	< 1500	< 1000
1,4-dichlorobenzene	106-46-7	> 120	< 120	< 90	< 60
ethylbenzene	100-41-4	> 1500	< 1500	< 1000	< 750
2-butoxyethanol	111-76-2	> 2000	< 2000	< 1500	< 1000
styrene	100-42-5	> 500	< 500	< 350	< 250
TVOC		> 2000	< 2000	< 1500	< 1000

Table 8 : VOC emission classes according to Order of April 19, 2011
(units: exposure concentrations at 28 days in $\mu\text{g}/\text{m}^3$)

Compounds	N° CAS	Cexp at 28 days	Emission class
formaldehyde	50-00-0	<LQ	A+
acetaldehyde	75-07-0	<LQ	A+
toluene	108-88-3	<LQ	A+
tetrachloroethylene	127-18-4	<LD	A+
xylene	108-38-3	<LQ	A+
1,2,4-trimethylbenzene	95-63-6	<LQ	A+
1,4-dichlorobenzene	106-46-7	<LD	A+
ethylbenzene	100-41-4	<LQ	A+
2-butoxyethanol	111-76-2	0	A+
styrene	100-42-5	<LQ	A+
TVOC	-	46	A+
Resulting emission class			A+

Table 9 : Exposure concentrations at 28 days ($\mu\text{g}/\text{m}^3$) from the 100% 6.6 NYLON (SBR Latex) carpet and resulting emission class (LD : detection limit, LQ : quantification limit)

VOC and ALD emissions from the 100% 6.6 NYLON (SBR Latex) carpet from TAI PING Carpets fulfil requirements of emission class **A+** of the French mandatory labelling system (according to Decree n° 2011-321 of March 23, 2011 and Order of April 19, 2011 modified by Order of February 20, 2012).

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ABSENCE OF RELEASE OF CMR COMPOUNDS

Compounds	N° CAS	Cexp at 28 days
trichloroethylene	79-01-6	0,6
benzene	71-43-2	<LQ
bis(2-ethylhexyl) phthalate*	117-81-7	0,8
dibutyl phthalate*	84-74-2	0,2
Compliance with Orders		YES

Table 10 : Emission of CMR compounds according to Order of April 30, 2009 and May 28, 2009 from the 100% 6.6 NYLON (SBR Latex) carpet (LD : detection limit, LQ : quantification limit) (* : not under accreditation)

Emissions of CMR compounds from the 100% 6.6 NYLON (SBR Latex) carpet comply with requirements of April 30, 2009 and May 28, 2009 Orders (exposure concentrations at 28 days < 1 µg/m³).

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ANNEX

Compounds	N° CAS	Detection limit (µg/m ³)	Quantification limit (µg/m ³)	Measured concentrations (µg/m ³) sampling 1	Measured concentrations (µg/m ³) sampling 2	Calibration
VOC (ISO 16000-6)						
benzene	71-43-2	0,3	0,9	< LD	< LD	specific
trichloroethylene	79-01-6	0,3	0,9	< LQ	< LQ	specific
dibutyl phthalate	84-74-2	0,5	1,5	< LD	< LD	specific
bis(2-ethylhexyl) phthalate	117-81-7	0,3	0,9	< LQ	< LD	specific
toluene	108-88-3	0,3	0,9	< LD	< LD	specific
tetrachloroethylene	127-18-4	0,5	1,5	< LD	< LD	specific
ethylbenzene	100-41-4	0,3	0,9	< LD	< LD	specific
m-xylene	108-38-3	0,3	0,9	< LD	< LD	specific
p-xylene	106-42-3	0,3	0,9	< LD	< LD	specific
styrene	100-42-5	0,3	0,9	< LD	< LD	specific
o-xylene	95-47-6	0,3	0,9	< LD	< LD	specific
2-butoxyethanol	111-76-2	0,3	0,9	< LQ	< LQ	specific
1,2,4-trimethylbenzene	95-63-6	0,3	0,9	< LD	< LD	specific
1,4-dichlorobenzene	106-46-7	0,3	0,9	< LD	< LD	specific
TVOC	-			40,4	49,1	toluene equivalent
ALD (ISO 16000-3)						
formaldehyde	50-00-0	0,1	0,3	< LQ	< LQ	specific
acetaldehyde	75-07-0	0,1	0,3	< LQ	< LQ	specific

Table 11 : Detection limit (LD), quantification limit (LQ) and measured concentrations of the two air samples (in µg/m³) from the 100% 6.6 NYLON (SBR Latex) carpet

End of test report