DIRECTION SANTE CONFORT
Division Physico-Chimie : Sources et Transferts de Polluants

Test report n° SC-16-022
concerning the ISOAFS-VINYL ECOSOFT ventilation duct (insulation thickness: 50 mm and 25 mm)

Mandatory labeling of VOC emissions

It comprises 10 pages.

Request by :

AFS BORU SANAYI A.S.
Ivedik Organize Sanayi Bolgesi 1468
Cadde No 153, Ostim
06370 Ankara, Turkey

OBJECTIVE

The purpose of this test is to characterize VOC and formaldehyde emissions from a flexible ventilation duct according to ISO 16000 standards and to check the compliance of their emissions with 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° 26057302

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).

Technicians in charge of testing: Gwendal LOISEL, Priscilla THIRY

Issued at Saint-Martin d'Hères, France,
April 4, 2016

Head of Unit

François MAUPETIT

1. Description of test samples

This test report is concerning the ISOAFS-VINYL ECOSOFT ventilation duct with 50 mm insulation from the AFS BORU SANAYI A.S. company.

Tested sample	Laboratory reference	Reception of sample	Start of testing		End of testing
			Test specimen preparation	Introduction in test chamber	
ISOAFS-VINYL ECOSOFT	Pol-16-04	19/02/2016	25/02/2016 ; 10:45	25/02/2016 ; 11:10	24/03/2016 ; 11:55

Table 1 : *Description of test sample*

2. Preparation of the test specimen

For this test, AFS provided CSTB with a flexible ventilation duct (length = 2 m, internal diameter = 0.152 m). For the preparation of the test specimen, CSTB has cut and opened one piece of this duct in order to fix it on a glass plate (internal face apparent). The external face and edges of the ventilation duct were covered using a low emission adhesive (Figure 1). Dimensions of the test specimen was 0.48 m per 0.14 m. Therefore, the emitting surface of the prepared test specimen was 0.067 m^2.

Figure 1 : *Test specimen of ISOAFS-VINYL ECOSOFT ventilation duct (internal face)*

3. Emission test chamber conditions

Just after preparation, the test specimen has been introduced in a glass emission test chamber. 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	22.6 ± 0.1 °C
Relative humidity	53.7 ± 0.5 %
Test specimen surface	0.067 m^2
Air flow rate	0.063 $m^3.h^{-1}$
Air exchange rate	1.24 h^{-1}
Product loading factor	1.31 $m^2.m^{-3}$
Area specific air flow rate (q_{test})	0.95 $m^3.m^{-2}.h^{-1}$
Test duration	28 days

Table 2 : *Testing conditions*

4. 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	2
Sorbent type	Tenax TA	Tenax TA	DNPH
Sampling duration	60 min.	60 min.	60 min.
Sampling air flow rate	100 $mL.min^{-1}$	75 $mL.min^{-1}$	600 $mL.min^{-1}$
Sampled air volume	6.0 L	4.5 L	36.0 L

Table 3 : *Sampling conditions*

5. VOC and formaldehyde measurement method

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

VOC are identified by mass spectrometry (MS) and quantified by 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.

Parameters	Analytical conditions
Thermo desorber	Perkin Elmer ATD 400
Desorption temperature	280 °C
Nitrogen flow rate	50 $mL.min^{-1}$
Desorption duration	20 min.
Secondary trap temperature	280 °C
Gas chromatograph / Mass spectrometer	VARIAN GC 3800 / MS Saturn 2000
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	DB-5 ms (length : 60 m, internal diameter : 0.25 mm, phase thickness : 1 µm)
FID temperature	270 °C
Mass spectrometer parameters	Trap (MS Saturn 2000) 70 eV 33-450 amu

Table 4 : *Analytical conditions for VOC analyses*

Sampling and measurements of formaldehyde and other carbonyl compounds 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
HPLC system	WATERS Alliance
Detection	UV (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 $mL.mn^{-1}$
Column temperature	35 °C

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

6. 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 $\mu g.m^{-2}.h^{-1}$), calculated according to EN ISO 16000-9 as:

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

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

SERa = Specific emission rate ($\mu g/m^2/h$)			
Compounds	**CAS nb**	**28 days**	**Calibration**
VOC (ISO 16000-6)			
benzene	71-43-2	0,2	specific
trichloroethylene	79-01-6	<LD	specific
dibutyle phtalate	84-74-2	<LQ	specific
bis(2-ethylhexyle) phtalate	117-81-7	<LQ	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	1,1	specific
o-xylene	95-47-6	<LQ	specific
2-butoxyethanol	111-76-2	<LD	specific
1,2,4-trimethylbenzene	95-63-6	<LQ	specific
1,4-dichlorobenzene	106-46-7	<LD	specific
TVOC	-	25,5	toluene equivalent
ALD (ISO 16000-3)			
formaldehyde	50-00-0	0,8	specific
acetaldehyde	75-07-0	0,7	specific

Table 6 : *VOC and ALD area specific emission rates ($\mu g.m^{-2}.h^{-1}$) from ISOAFS-VINYL ECOSOFT ventilation duct (LD: detection limit, LQ: quantification limit)*

7. Evaluation of VOC and ALD emissions

For the evaluation of VOC and formaldehyde emissions from building products, exposure concentrations in a reference room (C_{exp}) are calculated from area specific emission rates as:

$$C_{exp} = SER_a / q_{scenario}$$

where SER_a are the area specific emission rates ($\mu g.m^{-2}.h^{-1}$) and $q_{scenario}$ the area specific air flow rate for the selected conventional evaluation scenario in the model room specified in Order of April 19, 2011 on mandatory labelling (here, "walls" scenario: $q_{scenario}$ = 0.50 $m^3.m^{-2}.h^{-1}$).

Cexp = Exposure concentrations ($\mu g/m^3$)			
Compounds	**CAS nb**	**28 days**	**Calibration**
VOC (ISO 16000-6)			
benzene	71-43-2	0,3	specific
trichloroethylene	79-01-6	<LD	specific
dibutyle phtalate	84-74-2	<LQ	specific
bis(2-ethylhexyle) phtalate	117-81-7	<LQ	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	2,1	specific
o-xylene	95-47-6	<LQ	specific
2-butoxyethanol	111-76-2	<LD	specific
1,2,4-trimethylbenzene	95-63-6	<LQ	specific
1,4-dichlorobenzene	106-46-7	<LD	specific
TVOC	-	51,1	toluene equivalent
ALD (ISO 16000-3)			
formaldehyde	50-00-0	1,6	specific
acetaldehyde	75-07-0	1,4	specific

Table 7 : *VOC and ALD exposure concentrations ($\mu g.m^{-3}$) from ISOAFS-VINYL ECOSOFT ventilation duct (LD: detection limit, LQ: quantification limit)*

7.1. VOC EMISSION CLASS ACCORDING TO THE FRENCH LABELLING SYSTEM

		emission classes			
Compounds	**CAS number**	**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 : *Emission classes according to Order of April 19, 2011 (units: exposure concentrations at 28 days in µg.m^{-3})*

Compounds	CAS nb	Cexp at 28 days	Emission class
formaldehyde	50-00-0	2	A+
acetaldehyde	75-07-0	1	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	<LD	A+
styrene	100-42-5	2	A+
TVOC	-	51	A+
Resulting emission class			A+

Table 9 : *Exposure concentrations at 28 days (µg.m^{-3}) from ISOAFS-VINYL ECOSOFT ventilation duct and resulting emission class (LD: detection limit, LQ: quantification limit)*

VOC and ALD emissions from the ISOAFS-VINYL ECOSOFT ventilation duct fulfill requirements of 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).

7.2. ABSENCE OF RELEASE OF CMR COMPOUNDS

Compounds	CAS nb	Cexp at 28 days
trichlorethylene	79-01-6	<LD
benzene	71-43-2	0,3
bis(2-ethylhexyle) phtalate	117-81-7	<LQ
dibutyle phtalate	84-74-2	<LQ
Compliance with Orders		**YES**

Table 10 : *Release of CMR compounds: exposure concentrations at 28 days (µg.m^{-3}) from ISOAFS-VINYL ECOSOFT ventilation duct (LD: detection limit, LQ: quantification limit)*

None of the CMR compounds listed in Orders of April 30, 2009[1] and May 28, 2009[2] are released from the ISOAFS-VINYL ECOSOFT ventilation duct.

[1] Arrêté du 30 avril 2009 relatif aux conditions de mise sur le marché des produits de construction et de décoration contenant des substances cancérigènes, mutagènes ou reprotoxiques de catégorie 1 ou 2.
[2] Arrêté du 28 mai 2009 modifiant l'arrêté du 30 avril 2009 relatif aux conditions de mise sur le marché des produits de construction et de décoration contenant des substances cancérigènes, mutagènes ou reprotoxiques de catégorie 1 ou 2.