

Idétrading Sverige AB  
Robert Johnson  
Askims Verkstadväg 1  
43634 Askim

## Emission measurements after 28 days

(2 appendices)

### Object

One sample of a flooring product was delivered to RISE by the customer.

Product name:	<b>Public</b>
Production date:	2017-11-01
Batch:	21012
Size of sample:	1 sheet rolled up: 0.5 x 2.0 m
Date of sampling:	2017-11-29
Date of arrival to RISE:	2017-11-30

### Assignment

Emission measurement according to ISO 16000-9:2006 (Indoor air – Part 9: Determination of the emission of volatile organic compounds from building products and furnishing – Emission test chamber method), after 28 days regarding volatile organic compounds (VOC and VVOC/SVOC), carcinogenic substances (VOC-substances, EU Regulation No 1272/2008 Annex VI, cat 1A and 1B), formaldehyde and acetaldehyde (ISO 16000-3:2011). Evaluation according to EN 16516:2017 (EU-LCI values).

The results of the measurements will be used for registration to Byggsvarubedömningen.

For evaluation of test results the principle of shared risk is applied, i.e. for a max limit ( $\leq$ ) a result  $\leq$  the limit complies and a result  $>$  the limit does not comply (ILAC G8 section 2.7).

### Method

One test specimen was prepared by placing two pieces back-to-back. The edges were sealed with aluminum tape leaving a total surface area of 0.1m<sup>2</sup>. The specimen was placed in a room with controlled climate conditions of 23 ± 2 °C and 50 ± 5 % RH. The test specimen was placed in the emission chamber five days prior to the air sampling.

Air samplings after 28 days of conditioning were carried out on 2018-01-05.

Test conditions in the chamber:

Chamber volume:	0.25 m <sup>3</sup>
Temperature:	23 ± 1 °C
Relative humidity:	50 ± 5 % RH

### RISE Research Institutes of Sweden AB

Postal address	Office location	Phone / Fax / E-mail
Box 857	Brinellgatan 4	+46 10 516 50 00
SE-501 15 BORÅS	SE-504 62 BORÅS	+46 33 13 55 02
Sweden		info@ri.se

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Surface area of test specimen:	0.10 m <sup>2</sup>
Air exchange rate:	0.5 h <sup>-1</sup>
Area specific air flow rate:	5 m <sup>3</sup> /m <sup>2</sup> h.
Air velocity at specimen surface:	0.1 – 0.3 m/s

Tenax TA was used as adsorption medium for VOC. The tubes were thermally desorbed and analysed in accordance to RISE method 0601, similar to ISO 16000-6:2011 (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/FID). This means an analysis in a gas chromatograph and detection with a flame ionisation detector (FID) and mass selective detector (MS). The capillary column used is coated with 5% phenyl/ 95 % methylpolysiloxane. The FID signals are used for compound quantification. The total volatile organic compounds (TVOC) means compounds eluting between and including n-hexane to hexadecane, having boiling points in the range of about 70-260 °C. Minimum duplicate air samples were taken and the results are mean values. Sampled volumes are 3 to 9 L.

Tenax TA was also used as adsorption medium for testing of volatile carcinogenic compounds according to EU Regulation No 1272/2008 Annex VI, cat 1A and 1B), (exclusive formaldehyde), 1 µg/m<sup>3</sup> and above.

The samplings of aldehydes were carried out with DNPH samplers. The samplers were analysed according to RISE method 2302, similar to ISO 16000-3:2011 (Indoor air - Part 3: Determination of formaldehyde and other carbonyl compounds – Active sampling method). This means analysis on a liquid chromatograph with absorbance detector. Duplicate air samples were taken and the results are mean values. Sampled volumes were 30 to 50 L.

## Results

The results in Table 1 are expressed as area specific emission rates and as concentrations in a reference room (according to CEN/TS 16516:2013). The reference room has a base area of 3 m x 4 m and a height of 2.5 m, with an air exchange rate of 0.5 h<sup>-1</sup>. The wall area is 31.4 m<sup>2</sup>, floor area is 12 m<sup>2</sup>, small area, like a door, is 1.6 m<sup>2</sup> and very small area, like sealant, is 0.2 m<sup>2</sup>. Floor area is used for the calculation of the concentrations.

Calculation of the concentration from the emission rate:

$$C = \frac{E_a \times A}{n \times V}$$

C = concentration of VOC in the reference room, in µg/m<sup>3</sup>  
E<sub>a</sub> = area specific emission rate, in µg/m<sup>2</sup>h  
A = surface area of product in reference room, in m<sup>2</sup>  
n = air exchange rate, in changes per hour, here 0.5 h<sup>-1</sup>  
V = volume of the reference room, in m<sup>3</sup>, here 30 m<sup>3</sup>

**Table 1.**  
Emission results of **Public** after 28 days

Volatile organic compounds	CAS number	Retention time (min)	ID <sup>1</sup>	Emission rate ( $\mu\text{g}/\text{m}^2\text{h}$ )	Concentration in reference room ( $\mu\text{g}/\text{m}^3$ )	LCI <sub>i</sub> ( $\mu\text{g}/\text{m}^3$ )	R <sub>i</sub> ( $c_i/\text{LCI}_i$ )
<b>TVOC (C<sub>6</sub> – C<sub>16</sub>)</b>	--	6.5 – 38.1	B	31	25	--	--
<b>Volatile Carcinogens<sup>2</sup></b>		6.5 – 38.1					
No substances detected	--	--	B	< 1	< 1	--	--
<b>VOC with LCI<sup>3</sup></b>		6.5 – 38.1					
Styrene	100-42-5	15.9	A	3	< 5	250	--
2-ethyl-1-Hexanol	104-76-7	20.6	A	20	16	300	0.07
Hexanoic acid, 2-ethyl-	149-57-5	23.2	A	9	8	150	0.05
<b>∑ VOC with LCI</b>	--	--		32	26	--	--
<b>VOC without LCI<sup>4</sup></b>							
Phenol	108-95-2	18.6	B	16	12	--	--
<b>∑ VOC without LCI</b>	--	--		16	12	--	--
<b>SVOC (C<sub>16</sub> – C<sub>22</sub>)<sup>5</sup></b>		38.1 - 50.0					
No substances detected	--	--	B	< 2	< 5	--	--
<b>∑ SVOC</b>	--	--	B	< 2	< 5	--	--
<b>VVOC (&lt; C<sub>6</sub>)<sup>6</sup></b>		4.5 – 6.5					
Formaldehyde <sup>7</sup>	50-00-0	--	A	< 2	< 5	100	--
Acetaldehyde <sup>7</sup>	75-07-0	--	A	< 2	< 5	1 200	--
<b>∑ VVOC</b>	--	--	A	< 2	< 5	--	--
<b>R = ∑ C<sub>i</sub> / LCI<sub>i</sub><sup>8</sup></b>	--	--	--	--	--	--	0.12

<sup>1</sup>) ID: A = quantified compound specific, B = quantified as toluene-equivalent

<sup>2</sup>) Volatile carcinogens = VOCs according to EU Regulation No 1272/2008 Annex VI, cat 1A and 1B

<sup>3</sup>) VOC with LCI = identified VOC-compound with LCI-value according to EU-LCI, Dec 2016

<sup>4</sup>) VOC without LCI = VOC-compound without LCI-value or not identified.

<sup>5</sup>) SVOC = semi-volatile organic compounds, as defined in ISO 16000-6 (not part of accreditation)

<sup>6</sup>) VVOC = very volatile organic compounds, as defined in ISO 16000-6 (not part of accreditation)

<sup>7</sup>) VVOC-aldehydes measured with DNPH samplers (ISO 16000-3)

<sup>8</sup>) All VVOC, VOC, SVOC and carcinogens with LCI

Only VOC-compounds with an emission rate higher than  $2 \mu\text{g}/\text{m}^2\text{h}$  are listed in Table 1, carcinogenic compounds  $\geq 1 \mu\text{g}/\text{m}^3$ . Only the compounds with a concentration in the reference room  $> 5 \mu\text{g}/\text{m}^3$  are evaluated based on LCI (= lowest concentration of interest). TVOC expressed in  $\mu\text{g}/\text{m}^3$  is the sum of all individual substances with concentrations  $\geq 5 \mu\text{g}/\text{m}^3$  (in toluene equivalents).

Quantification limit for TVOC is  $10 \mu\text{g}/\text{m}^2\text{h}$ . Measurement uncertainty for VOC is 15 % (rel) and for formaldehyde 30 % (rel). Background of TVOC in the empty chamber was below  $20 \mu\text{g}/\text{m}^3$  and is subtracted.

See Appendix 1 for a gas chromatogram (FID spectra) and Appendix 2 for a photo of the test specimen.

## Summary of the test results

The test results are summarized in Table 2.

**Table 2.**  
Summary of the emission results after 28 days of **Public**

Compounds	Emission rate ( $\mu\text{g}/\text{m}^2\text{h}$ )	Concentration in reference room (Floor scenario) ( $\mu\text{g}/\text{m}^3$ )
TVOC	31	25
$\Sigma$ Carcinogenic VOCs	< 1	< 1
$\Sigma$ VOC with LCI	32	26
$\Sigma$ VOC without LCI	16	12
$\Sigma$ VVOC	< 2	< 5
$\Sigma$ SVOC	< 2	< 5
$R = \Sigma C_i / LCI_i$	0.12	

## Evaluation of the test results

Byggvarubedömningen has criteria regarding Emissions to indoor environment. The emissions are to measured according to a standard method such as ISO 16000-9. The requirements for the *Recommended class* is that the requirements to one of the following systems are being met: Emission EC1, Emission EC1<sup>PLUS</sup>, Blue Angel, M1 (RTS) or GUT.

**Table 3.**  
The test results of **Public** are compared to the relevant requirements in M1

Compounds	Requirement M1 ( $\text{mg}/\text{m}^2\text{h}$ )	Test Results ( $\text{mg}/\text{m}^2\text{h}$ )	Pass / Fail
TVOC	< 0.2	<b>0.031</b>	<b>PASS</b>
Formaldehyde	< 0.05	<b>&lt; 0.002</b>	<b>PASS</b>
CMR 1A+1B	< 0.005	<b>&lt; 0.001</b>	<b>PASS</b>
Ammonia	< 0.03	not measured	--
Odour	$\geq 0.0$	not measured	--

The test results are in compliance with the tested requirements of M1 and meet the requirements for the *Recommended class*.

**RISE Research Institutes of Sweden AB**  
**Chemistry and Materials - Chemistry**

Performed by

Examined by

Thomas Vaessen

Tove Mali'n

**Appendices**

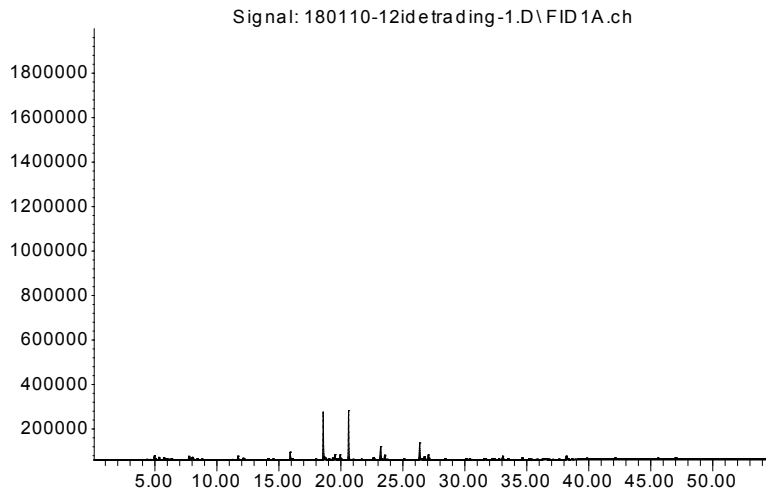
1. Gas Chromatogram
2. Photo of the test specimen

## Appendix 1

## Gas chromatogram

Public, after 28 days:

Abundance



TVOC between  $C_6$  and  $C_{16}$ , means compounds eluting between 6.5 and 38.1 minutes.

## Appendix 2

**Photo of test specimen****Public**