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Emission measurements after 28 days

(3 appendices)

Object

One sample of a writing board was delivered to RISE by the customer.

Product name:	Whiteboard Air
Production week:	2019-09
Size of sample:	350 x 350 x 10 mm wrapped in original cardboard
Date of arrival to RISE:	2019-03-05
Date of analysis:	week 10 - 16, 2019

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).

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

The test was started 2019-03-08 by unwrapping the test piece. The specimen was placed in a separate conditioning container (with air velocity of ca 0.2 m/s) in a room with controlled climate conditions of 23 ± 2 °C and 50 ± 5 % RH. The test specimen was placed into the chamber three days prior to air samplings. Air samplings after 28 days of conditioning were carried out on 2019-04-05.

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Test conditions in the chamber:

Chamber volume:	0.25 m ³
Temperature:	23 ± 0.5 °C
Relative humidity:	50 ± 5 % RH
Surface area of test specimen:	0.12 m ²
Air exchange rate:	0.5 h ⁻¹
Area specific air flow rate:	1.0 m ³ /m ² 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 6 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/m³ 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 EN 16516:2017). 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⁻¹. The wall area is 31.4 m², floor area is 12 m², small area, like a door, is 1.6 m² and very small area, like sealant, is 0.2 m². **Small 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/m³
 E_a = area specific emission rate, in µg/m²h
 A = surface area of product in reference room, in m²
 n = air exchange rate, in changes per hour, here 0.5 h⁻¹
 V = volume of the reference room, in m³, here 30 m³

Table 1.
Emission results of **Whiteboard Air** after 28 days

Volatile organic compounds	CAS number	Retention time (min)	ID ¹	Emission rate (µg/m ² h)	Concentration in reference room (µg/m ³)	LCI _i (µg/m ³)	R _i (c _i /LCI _i)
TVOC (C ₆ – C ₁₆)	--	6.9 – 39	B	100	< 10	--	--
Volatile Carcinogens ²		6.9 – 39					
No substances detected	--	--	B	< 1	< 1	--	--
VOC with LCI ³		6.9 – 39					
Pentanal	110-62-3	9.3	A	17	< 5	800	--
Propylene Glycol	57-55-6	10.2	A	82	9	2100	0.004
1-Pentanol	71-41-0	11.3	A	5	< 5	730	--
Hexanal	66-25-1	12.6	A	45	5	900	0.005
Pentanoic acid	109-52-4	14.7	A	7	< 5	2100	--
Hexanoic acid	142-62-1	18.5	A	26	< 5	2100	--
2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate	25265-77-4	32.7+33.2	A	11	< 5	600	--
Σ VOC with LCI	--	--	A	190	14	--	--
VOC without LCI ⁴		6.9 – 39					
Dipropylene glycol n-butyl ether	29911-28-2	28.5+28.6	A	14	< 5	--	-
Σ VOC without LCI	--	--	B	14	< 5	--	--
SVOC (C ₁₆ – C ₂₂) ⁵		39 - 52					
No substances detected	--	--	B	< 2	< 5	--	--
Σ SVOC	--	--	B	< 2	< 5	--	--
VVOC (< C ₆) ⁶		5.4 – 6.9					
Formaldehyde ⁷	50-00-0	--	A	< 2	< 5	100	--
Acetaldehyde ⁷	75-07-0	--	A	8	< 5	1 200	--
Σ VVOC	--	--	A	8	< 5	--	--
R = Σ C _i / LCI _i ⁸	--	--	--	--	--	--	< 0.01

¹⁾ ID: A = quantified compound specific, B = quantified as toluene-equivalent

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

³⁾ VOC with LCI = identified VOC-compound with LCI-value according to EU-LCI, July 2018

⁴⁾ VOC without LCI = VOC-compound without LCI-value or not identified.

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

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

⁷⁾ VVOC-aldehydes measured with DNPH samplers (ISO 16000-3)

⁸⁾ All VVOC, VOC, SVOC and carcinogens with LCI

Only VOC-compounds with an emission rate higher than 2 µg/m²h are listed in Table 1, carcinogenic compounds ≥ 1 µg/m²h. 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). The emission rate of TVOC ($\mu\text{g}/\text{m}^2\text{h}$) includes all compounds $\text{ca} \geq 1 \mu\text{g}/\text{m}^2\text{h}$ in the chamber.

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 **Whiteboard Air**

Compounds	Emission rate ($\mu\text{g}/\text{m}^2\text{h}$)	Concentration in reference room (small area scenario) ($\mu\text{g}/\text{m}^3$)
TVOC	100	< 10
$\sum$ Carcinogenic VOCs	< 1	< 1
$\sum$ VOC with LCI	190	14
$\sum$ VOC without LCI	14	< 5
$\sum$ VVOC	8	< 5
Formaldehyde	< 2	< 5
$\sum$ SVOC	< 2	< 5
$R = \sum C_i / \text{LCI}_i$	< 0.01	

Evaluation of the test results

Bygghälsöversynen has criteria regarding Emissions to indoor environment. The emissions are to be measured according to a standard method such as ISO 16000-9 after 28 days regarding VOC and formaldehyde. The requirements for the *Recommended class* is that the requirements to one of the following systems are being met: Emicode EC1, Emicode EC1^{PLUS}, Blue Angel, M1 (RTS) or GUT. The results of the tested sample are compared to M1.

Table 3.

The test results of **Whiteboard Air** compared to the relevant requirements in M1

Compounds	Requirement M1 (mg/m ² h)	Test Results (mg/m ² h)	Pass / Fail
TVOC	< 0.2	0.100	PASS
Formaldehyde	< 0.05	< 0.002	PASS
CMR 1A+1B	< 0.001	< 0.001	PASS
Single VOC (µg/m ³)	≤ EU-LCI	≤ EU-LCI	PASS
Ammonia	< 0.03	not measured	--
Odour	≥ 0.0	not measured	--

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

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Performed by

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Appendices

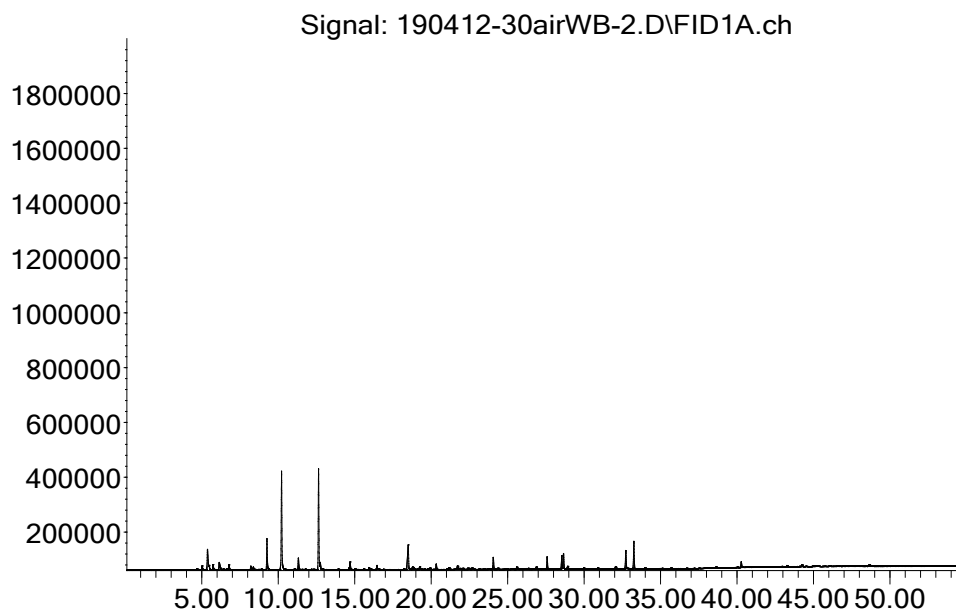
1. Gas Chromatogram
2. Photo of the test specimen

Appendix 1

Gas chromatogram

Whiteboard Air, after 28 days:

Abundance



TVOC between C₆ and C₁₆, means compounds eluting between 6.9 and 39 minutes.

Appendix 2

Photo of the test specimen