

BB Stål AS
Liaveien 25
NO-3046 DRAMMEN
Norge

Emission measurement after 28 days

(1 appendix)

Test object

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

Product name: **White COREX**
Manufacturer: Dalsan Alçı, Turkey
Size of sample: Approx. 1 x 1 m, thickness 12.5 mm
Date of arrival: 2018-09-06

Assignment

Emission measurements according to SS-EN 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 approval by SINTEF.

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 on September 7. The plasterboard was cut in two halves which were placed back to back. The cut edges and part of the surface were sealed with aluminium tape leaving an exposed surface area of 0.93 m². The specimen was placed in a room with controlled climate conditions of 23 ± 3 °C and 50 ± 5 % RH. The test specimen was placed in the emission chamber three days prior to the air sampling.

Air samplings after 28 days of conditioning were carried out on 2018-10-05.

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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Conditions of the test in the emission chamber:

Test chamber volume:	1.0 m ³
Area of test specimen:	0.93 m ²
Air exchange rate:	0.5 h ⁻¹
Area specific air change rate:	0.54 m ³ /m ² h.
Temperature:	23 ± 1 °C
Relative humidity:	50 ± 5 % RH
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 2.6 – 4.3 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 50 – 60 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 1.5 m² and very small area, like sealant, is 0.2 m². Wall 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
V = volume of the reference room, in m³

Table 1.
Emission results of **White COREX** after 28 days

Volatile organic compounds	CAS number	Retention time (min)	ID ¹	Emission rate ($\mu\text{g}/\text{m}^2\text{h}$)	Concentration in reference room ($\mu\text{g}/\text{m}^3$)	LCI _i ($\mu\text{g}/\text{m}^3$)	R _i (c_i/LCI_i)
TVOC (C ₆ – C ₁₆)	--	5.6 – 38.2	B	< 10	6	--	--
Volatile Carcinogens ²		5.6 – 38.2					
No substances detected	--	--	B	< 1	< 1	--	--
VOC with LCI ³		5.6 – 38.2					
Nonanal	124-19-6	24.1	A	6	11	900	0.01
Σ VOC with LCI	--	--	A	6	11	--	--
VOC without LCI ⁴		5.6 – 38.2					
No substances detected	--	--	B	< 2	< 5	--	--
Σ VOC without LCI	--	--	B	< 2	< 5	--	--
SVOC (C ₁₆ – C ₂₂) ⁵		38.2 – 51.3					
No substances detected	--	--	B	< 2	< 5	--	--
Σ SVOC	--	--	B	< 2	< 5	--	--
VVOC (< C ₆) ⁶		4.0 – 5.6					
Formaldehyde ⁷	50-00-0	--	A	2	4	--	--
Acetaldehyde ⁷	75-07-0	--	A	< 1	1	--	--
Σ VVOC	--	--	A	< 3	5	--	--
R = $\Sigma C_i / \text{LCI}_i$ 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, Dec 2016

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

n.d. = not detected (detection limit is approx 1 $\mu\text{g}/\text{m}^2\text{h}$).

COMMENT:

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 $\geq 1 \mu\text{g}/\text{m}^2\text{h}$. Only compounds with a concentration in the model room $\geq 5 \mu\text{g}/\text{m}^3$ 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 approximately $\geq 1 \mu\text{g}/\text{m}^2\text{h}$ (in toluene equivalents) in the chamber.

Quantification limit for TVOC is 10 $\mu\text{g}/\text{m}^2\text{h}$. Measurement uncertainty for TVOC 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 gas chromatograms (FID spectra)

The test results are summarized in Table 2.

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

Compounds	Emission rate ($\mu\text{g}/\text{m}^2\text{h}$)	Concentration in reference room (wall scenario) ($\mu\text{g}/\text{m}^3$)
TVOC	< 10	6
Σ Carcinogenic VOCs	< 1	< 1
Σ VOC with LCI	6	11
Σ VOC without LCI	< 2	< 5
Σ VVOC	< 3	5
Σ SVOC	< 2	< 5
$R = \Sigma C_i / LCI_i$	0.01	

Evaluation of the test results

SINTEF Technical Approvals has emission criteria according to Table 3.

Table 3.
The test results of **White COREX** are compared to the requirements of SINTEF for floor/ceiling, wall and small areas:

Compounds	Requirement Sintef ($\mu\text{g}/\text{m}^2\text{h}$)	Test Results ($\mu\text{g}/\text{m}^2\text{h}$)	Pass / Fail
TVOC	< 200	< 10	PASS
Formaldehyde	< 50	2	PASS
Sum of carcinogenic VOC	< 10	< 1	PASS

The test results are in compliance with the requirements of SINTEF.

RISE Research Institutes of Sweden AB
Chemistry and Materials - Chemistry

Performed by

Examined by

Ulrika Johansson

Tove Malin

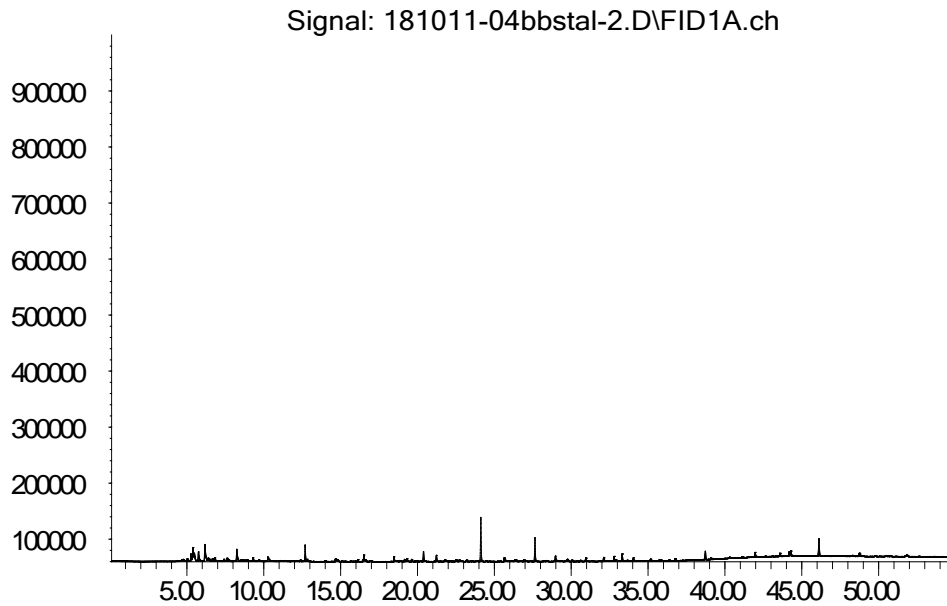
Appendix

1. Gas chromatogram

Appendix 1

Gas chromatogram**White COREX** after 28 days
(sampled volume 4.3L)

Abundance

TVOC between C₆ and C₁₆, means compounds eluting between 5.6 and 38.2 minutes.