REPORT
issued by an Accredited Testing Laboratory

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Emission measurements according to ANSI/BIFMA M7.1-2011

(2 appendices)

Object

One sample of an office desk top with legs and control equipment was delivered by car by the client.

Sample marking:	**Bord P168**, plastlaminat vit, färg vit Ben1 SS/P 800 635-1285 MM, 2 st Styrutrustning SS/P 2-ben, Sv Eu kontakt 0.3W
Production date:	Order 2662704, series P, 5777
Date of arrival:	2015-08-04

Work requested

Emission measurements according to **ANSI/BIFMA M7.1-2011** (Standard Test Method for Determining VOC Emissions From Office Furniture Systems, Components and Seating), with air samples taken from the test chamber at the 72nd and 168th hour regarding volatile organic compounds (VOC), formaldehyde and aldehydes.

Method

At the day of arrival, the test specimens were wrapped in aluminium foil and plastic foil and stored in a room with controlled climate conditions of 23 ± 2 °C and 50 ± 10 % RH.

The test specimens were unpacked and placed in the test chamber 2015-08-07.

Test conditions in chamber:

Chamber volume:	22.0 m^3
Temperature:	23 ± 0.5 °C
Relative humidity:	50 ± 3 % RH
Air exchange rate:	0.3 h^{-1}
Area of sample:	1.3 m^2
Area specific air flow rate:	5.2 m^3/m^2 h.
Loading:	0.059 m^2/m^3 (1 desk/chamber volume)
Air samplings day 3:	2015-08-10
Air samplings day 7:	2015-08-14

Tenax TA was used as adsorption medium for VOC. The Tenax tubes were thermally desorbed and analysed in accordance 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), accredited SP method 0601. This means an analysis in a gas chromatograph and detection with a flame ionisation detector (FID) and mass selective detector (MS). The FID signals are used for compound quantification. The TVOC is quantified in toluene equivalents and includes all compounds ca ≥ 1 µg/m^3. The mass selective detector is used for identification of single compounds, quantified in compound specific amounts when possible, otherwise in toluene equivalents. Minimum duplicate air samples were taken and the results are mean values.

The samplings of Formaldehyde, Acetaldehyde and Propanal were carried out with DNPH samplers. The samplers were analysed according to ISO 16000-3:2001 -Indoor air--Part 3:Determination of formaldehyde and other carbonyl compounds – Active sampling method, accredited SP method 2302. This means analysis on a liquid chromatograph with UV absorbance detector. The other aldehydes (Butanal, Pentanal, Hexanal, Heptanal, Octanal, Nonanal and Benzaldehyde) were analyzed by GC-MS/FID by sampling on Tenax TA. Duplicate air samples were taken and the results are mean values.

Results

The results of the emission tests are summarized on the following pages in accordance with the BIFMA M7.1-2011 guidelines for reporting:

Table 1.
Chamber concentrations of VOCs between n-C_5 and n-C_{17} measured by GC-MS/FID (µg/m^3)

Volatile organic compound	CAS	RT (min)	ID	72nd hour				168th hour			
				# 1	# 2	**Mean**	% diff	# 1	# 2	**Mean**	% diff
Aromatic Hydrocarbons											
m- and p-Xylene	108-38-3 +106-42-3	14.0	A	1	1	**1**	20	1	1	**1**	1
o-Xylene	95-47-6	14.9	A	1	1	**1**	17	1	1	**1**	5
Terpenes											
α-Pinene	80-56-8	16.3	A	2	1	**1**	29	1	1	**1**	4
TVOC	--	4.5-39.2	B	5	4	**4**	25	4	5	**4**	20

Sorbent tube and media: Stainless steel tube with Tenax-TA; Sampling volumes: 2 – 11 L
ID: A = quantified compound specific, B = quantified in toluene equivalents

Table 2.
Chamber concentrations of Formaldehyde, Acetaldehyde and Total Aldehydes by HPLC and GC-MS/FID Analysis ($\mu g/m^3$)

Volatile organic compound	72nd hour				168th hour			
	# 1	# 2	**Mean**	% diff	# 1	# 2	**Mean**	% diff
Formaldehyde	1	< 1	**1**	--	1	1	**1**	30
Acetaldehyde	< 1	< 1	**< 1**	--	< 1	< 1	**< 1**	--
Total Aldehydes	2	< 1	**1**	--	1	2	**1**	28

Sampling cartridges: silica gel coated with DNPH; Sampling volumes: 44 – 110 L
Total aldehydes are defined as the sum of all normal-between n-C_1 and n-C_9-aldehydes plus benzaldehyde.

The results in table 3 are expressed as area specific emission rates. The emission factors are calculated by:

$$SER_A = \frac{Conc \times n}{L}$$

SER_A = area specific emission rate, in $\mu g/m^2$ x h
Conc = concentration of a VOC in the chamber, in $\mu g/m^3$
n = air exchange rate in the chamber, in changes per hour
L = loading factor, in m^2/m^3 (area of sample/volume of chamber)

Table 3.
Calculated Emission Factors for Identified VOCs, TVOC, Formaldehyd, Acetaldehyde and Total Aldehydes ($\mu g/m^2h$)

Volatile organic compound	Emission factor	
	72nd hour (3 days)	**168th hour (7 days)**
$TVOC_{Toluene}$	21	**21**
Formaldehyde	6	**7**
Acetaldehyde	< 1	**< 1**
Total Aldehydes ($\mu mol/m^2h$)	< 1	**< 1**
4-Phenylcyclohexene	< 1	**< 1**
Individual VOC:		
m- and p-Xylene	5	**5**
o-Xylene	5	**5**
α-Pinene	5	**5**

Background of TVOC in the empty chamber was < 10 $\mu g/m^3$. The background value is subtracted. Measurement uncertainty: TVOC 15 % (rel), formaldehyde 30 % (rel).

See Appendix 1 for gas chromatograms (FID spectra).

Appendix 2 is a photo of the test specimens in the emission chamber.

Evaluation of Test Results

The data obtained from the emissions testing of an individual furniture component is compared to the **ANSI/BIFMA X7.1-2011** (Standard for Formaldehyde and TVOC Emissions of Low-emitting Office Furniture and Seating). The following criteria from ANSI/BIFMA X7.1-2011 must be met at the seven-day time point specified in the ANSI/BIFMA M7.1-2011:

Table 4.
Workstation or Individual Furniture Components Maximum Emission Factors (according to ANSI/BIFMA, X7.1-2011 Table A1.2)

Volatile organic compound	ANSI/BIFMA M7.1 Open Plan Office Environment
Formaldehyde (µg/m^{2}h)	42.3
TVOC (µg/m^{2}h)	345
Total Aldehydes (µmol/m^{2}h)	2.8
4-Phenylcyclohexene (µg/m^{2}h)	4.5

Table 5.
Comparison of Emission Factors for the tested product and Maximum Emission Factors (ANSI/BIFMA X7.1-2011)

Volatile organic compound	Maximum Emission Factors Open Plan Office Environment	Emission Factors for **Bord P168**	Pass / Fail Result
Formaldehyde (µg/m^{2}h)	42.3	7	**PASS**
TVOC (µg/m^{2}h)	345	21	**PASS**
Total Aldehydes (µmol/m^{2}h)	2.8	< 1	**PASS**
4-Phenylcyclohexene (µg/m^{2}h)	4.5	< 1	**PASS**

Summary of test results

The emission factors for the tested product **Bord P168** are in compliance with the maximum emission factors of ANSI/BIFMA X7.1-2011.

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Performed by

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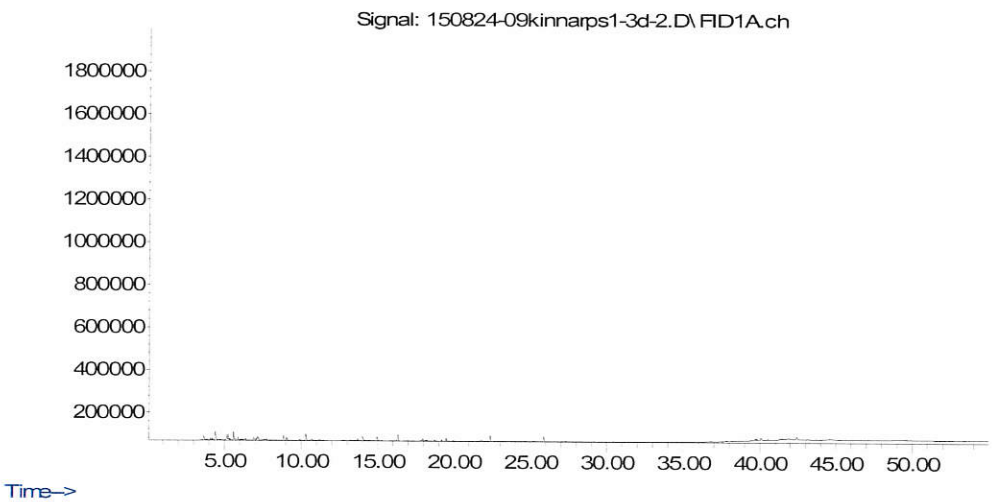
Appendices

1. Gas Chromatograms
2. Photo of test specimens

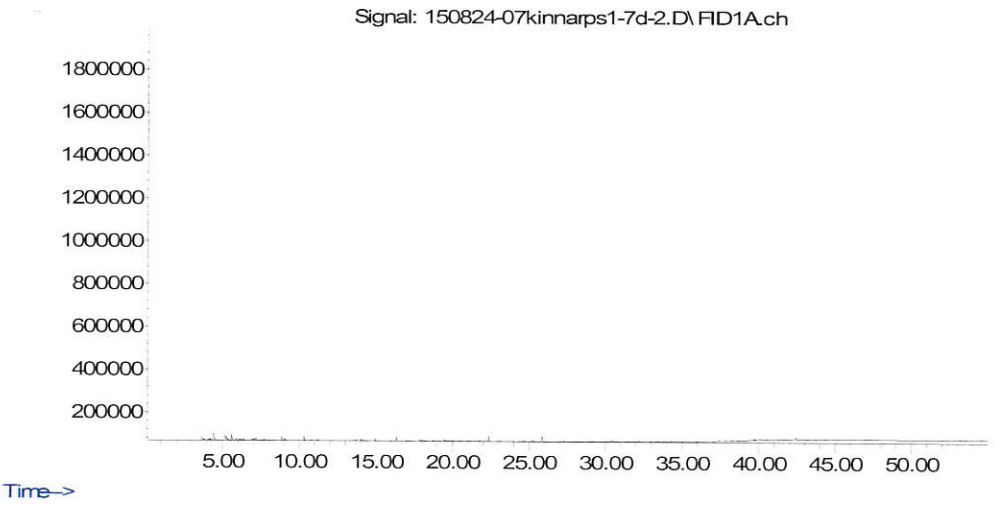
Appendix 1

Gas Chromatograms

Bord P168, after 3 days:



Bord P168, after 7 days:



Appendix 2

Photo of test specimens in the emission chamber