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## Emission measurement according to ANSI/BIFMA M7.1 (3 appendices)

### Object

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

Product name:	<b>Penne trä, bets svart</b>
Date of manufacturing:	2020-03-03
Date of arrival to RISE:	2020-03-05
Date of analysis:	week 10-12, 2020

### Assignment

Emission measurements according to ANSI/BIFMA M7.1-2011(R2016) (Standard Test Method for Determining VOC Emissions from Office Furniture Systems, Components and Seating), with air samples taken from the test chamber at the 72<sup>nd</sup> (3 days) and 168<sup>th</sup> hour (7 days) regarding volatile organic compounds (VOC), formaldehyde and other aldehydes.

### Method

Prior the emission testing, the test specimen was stored in the original shipping container in a room with controlled climate conditions of  $23 \pm 2$  °C and  $50 \pm 20$  % RH.

The chair was unpacked and placed in the test chamber 2020-03-06.

Test conditions in the chamber:

Chamber volume:	1.0 m <sup>3</sup>
Temperature:	$23 \pm 0.5$ °C
Relative humidity:	$50 \pm 3$ % RH
Air exchange rate:	$1.0 \text{ h}^{-1} = 0.28 \text{ L/s}$
Loading:	1.0 unit/m <sup>3</sup> (1 chair/chamber volume)
Air samplings day 3:	2020-03-09
Air samplings day 7:	2020-03-13

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 or MS/FID). This means an analysis in a gas chromatograph and detection with a flame ionisation detector (FID) and mass

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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 were 1 to 6 L.

The samplings of Formaldehyde, Acetaldehyde and Propanal 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. 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. Sampled volumes were 45 to 110 L.

## Results

The results relate only to the items tested.

The results of the emission tests are summarized on the following pages in accordance with the ANSI/BIFMA M7.1-2011(R2016) guidelines for reporting:

**Table 1.**  
**Concentrations of Formaldehyde and Acetaldehyde by HPLC analysis (µg/m<sup>3</sup>)**

Volatile organic compound	72 <sup>nd</sup> hour				168 <sup>th</sup> hour			
	# 1	# 2	Mean	% diff	# 1	# 2	Mean	% diff
Formaldehyde	0.3	0.6	<b>0.5</b>	60	0.3	0.3	<b>0.3</b>	13
Acetaldehyde	0.6	0.6	<b>0.6</b>	3	0.4	0.6	<b>0.5</b>	20
<b>Total Aldehydes</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>27</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>11</b>

Total aldehydes are defined as the sum of all normal aldehydes between n-C<sub>1</sub> and n-C<sub>9</sub>-aldehydes plus benzaldehyde.

**Table 2.**  
**Concentrations of VOCs between n-C<sub>6</sub> and n-C<sub>16</sub> measured by GC-MS/FID (µg/m<sup>3</sup>)**

Volatile organic compound	CAS	RT (min)	ID	72 <sup>nd</sup> hour				168 <sup>th</sup> hour			
				# 1	# 2	Mean	% diff	# 1	# 2	Mean	% diff
<b>Glycols / Glycol Ethers</b>											
Ethanol, 2-butoxy-	111-76-2	16.5	A	1100	1100	<b>1100</b>	2	540	550	<b>540</b>	1
Dipropylene glycol monomethylether	34590-94-8	19.8-20.4	A	88	86	<b>87</b>	1	42	42	<b>42</b>	1
Dipropylene glycol n-butyl ether	29911-28-2	28.4-29.3	A	1100	1100	<b>1100</b>	5	630	640	<b>640</b>	1
<b>Others</b>											
Unknown	--	37.1	B	7	8	<b>8</b>	8	6	7	<b>6</b>	5
<b>TVOC</b>											
	--	6.9-39	B	1200	1200	<b>1200</b>	2	650	650	<b>650</b>	1

ID: A = quantified compound specific, B = quantified in toluene equivalents

The background of TVOC in the empty chamber was  $< 10 \mu\text{g}/\text{m}^3$ . The background of formaldehyde in the empty chamber was  $< 1 \mu\text{g}/\text{m}^3$ . The background values are subtracted.

**Table 3.**  
**Calculated Emission Factors for Identified VOCs, TVOC, Formaldehyd, Acetaldehyde and Total Aldehydes ( $\mu\text{g}/\text{h}$  unit)**

Volatile organic compound	Emission factor	
	72 <sup>nd</sup> hour (3 days)	168 <sup>th</sup> hour (7 days)
TVOC <sub>Toluene</sub>	1200	650
Formaldehyde ( $\mu\text{mol}/\text{h}$ unit)	$< 1$	$< 1$
Acetaldehyde ( $\mu\text{mol}/\text{h}$ unit)	$< 1$	$< 1$
Total Aldehydes ( $\mu\text{mol}/\text{h}$ unit)	$< 1$	$< 1$
4-Phenylcyclohexene	$< 2$	$< 2$
Individual VOC:		
Ethanol, 2-butoxy-	1100	540
Dipropylene glycol monomethylether	87	42
Dipropylene glycol n-butyl ether	1100	640
Unknown	8	6

The results in table 4 are expressed as predicted concentrations in a standard office environment. The concentrations are calculated by:

$$Conc_{Build} = \frac{Conc_{Chamber} \times n}{Q}$$

$Conc_{Build}$  = estimated building concentration of a VOC, in  $\text{mg}/\text{m}^3$   
 $Conc_{Chamber}$  = concentration of a VOC in the chamber, in  $\text{mg}/\text{m}^3$   
 $n$  = air exchange rate in the chamber, in changes per hour,  $1 \text{ m}^3/\text{h}$   
 $Q$  = modelled air flow for a chair in a standard office,  $24.8 \text{ m}^3/\text{h}$

**Table 4.**  
**Predicted Concentrations in a Standard Office Environment of a Seating**  
(assuming a ventilation rate of  $24.8 \text{ m}^3/\text{h}$ )

Volatile organic compound	Based on the measured data	
	72 <sup>nd</sup> hour (3 days)	168 <sup>th</sup> hour (7 days)
TVOC ( $\text{mg}/\text{m}^3$ )	0.048	<b>0.026</b>
Formaldehyde (ppb)	$< 0.1$	<b><math>&lt; 0.1</math></b>
Total Aldehydes (ppb)	$< 0.1$	<b><math>&lt; 0.1</math></b>
4-Phenylcyclohexene ( $\text{mg}/\text{m}^3$ )	$< 0.001$	<b><math>&lt; 0.001</math></b>
Individual VOC ( $\text{mg}/\text{m}^3$ ):		
Ethanol, 2-butoxy-	0.044	<b>0.022</b>
Dipropylene glycol monomethylether	0.004	<b>0.002</b>
Dipropylene glycol n-butyl ether	0.044	<b>0.026</b>
Unknown	$< 0.001$	<b><math>&lt; 0.001</math></b>

Measurement uncertainty: TVOC 15 % (rel), formaldehyde and acetaldehyde 30 % (rel).

See Appendix 1 for gas chromatograms (FID spectra) and Appendix 2 for a photo of the test specimen. Appendix 3 is the sampling report received from the customer.

## Evaluation of Test Results

The data obtained from emissions testing of the seating is compared to the ANSI/BIFMA X7.1-2011(R2016) (Standard for Formaldehyde & TVOC Emissions of Low-emitting Office Furniture and Seating). These criteria must be met at the seven-day time point specified in the ANSI/BIFMA M7.1-2011(R2016).

Decision rule: When comparing the measured results and requirement level, the average value of the measured results has been compared with the requirement level. No account is taken to the measurement uncertainty.

**Table 5.**

**Comparison of Predicted Air Concentrations for the tested Penne trä, bets svart and Maximum Indoor Air Concentrations (ANSI/BIFMA X7.1-2011(R2016))**

Volatile organic compound	Maximum Indoor Air Concentrations (ANSI/Bifma X7.1-2011(R2016))	Predicted Air Concentrations of <u>Penne trä, bets svart</u>	PASS / FAIL
TVOC	0.25 mg/m <sup>3</sup>	<b>0.026 mg/m<sup>3</sup></b>	PASS
Formaldehyde	25 ppb	<b>&lt; 0.1 ppb</b>	PASS
Total Aldehydes	50 ppb	<b>&lt; 0.1 ppb</b>	PASS
4-Phenylcyclohexene	0.0032 mg/m <sup>3</sup>	<b>&lt; 0.001 mg/m<sup>3</sup></b>	PASS

### Summary of the results:

The tested product **Penne trä, bets svart** meets the requirements for seating of the standard ANSI/BIFMA X7.1-2011(R2016).

## RISE Research Institutes of Sweden AB Materials and Production – Chemical and Biological Safety

Performed by

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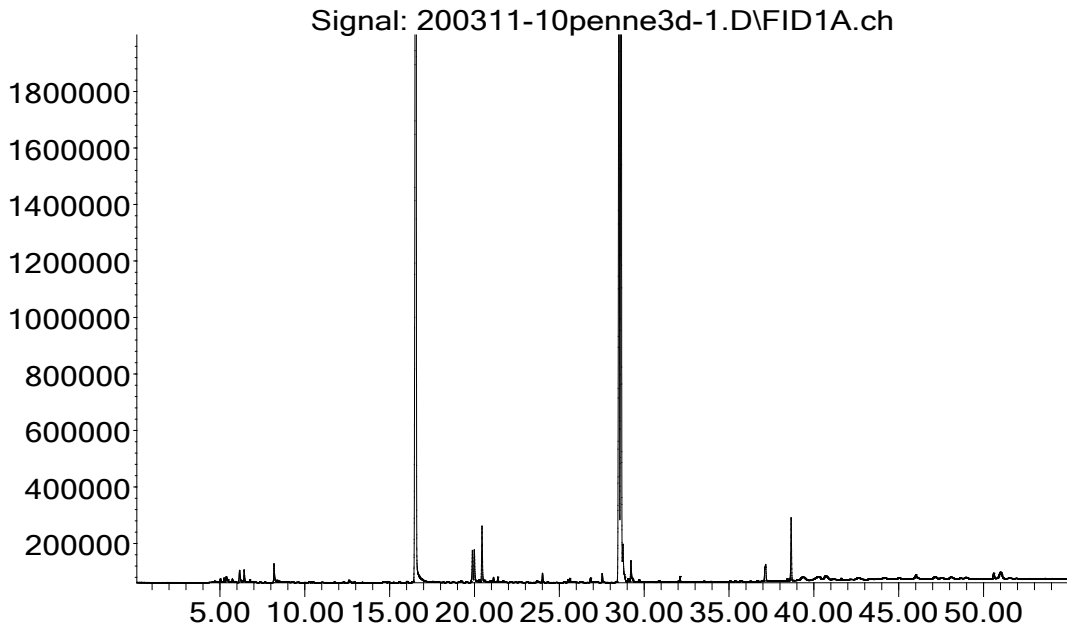
## Appendices

1. Gas Chromatograms
2. Photo of the test specimen
3. Sampling report

Appendix 1

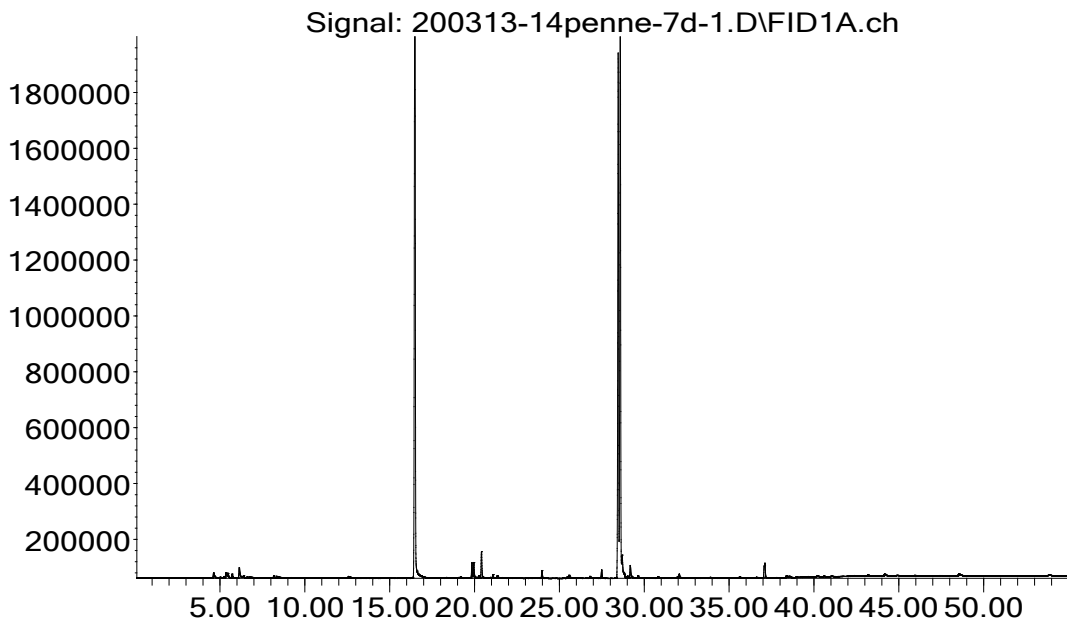
**Gas chromatograms**

After 3 days:  
Abundance



Time-->

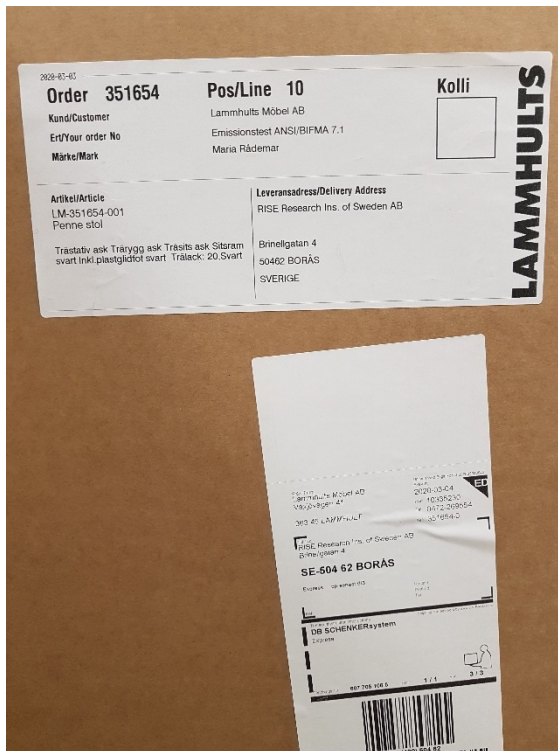
After 7 days:  
Abundance



Time-->

TVOC between C<sub>6</sub> and C<sub>16</sub>, means compounds eluting between 6.9 and 39 minutes.

## Appendix 2

**Photo of the test specimen**

Appendix 3

Sampling Report

<b>Sampler</b> (Name, Company, contact info):  Lammhults Möbel AB info@lammhults.se hkt@lammhults.se 0472-269500	<b>Manufacturer of the product</b> (Company, address):  Lammhults Möbel AB Växjövägen 41 363 45 Lammhult
<b>Name of product:</b> Penne trä, bets svart	<b>Type of product:</b> Stol
<b>Manufacturing Date:</b> 2020-03-03	<b>Batch No:</b> 351654
<b>Date of sampling:</b>  2020-03-03	<b>Amount/size of material sampled:</b> 1  <b>Packing material:</b> Plast, kartong
<b>Sample is taken from:</b> Production line <input checked="" type="checkbox"/> X Stock / Storage <input type="checkbox"/> Miscellaneous <input type="checkbox"/> -where, specify:	<b>How was the product stored before sampling?</b>
<b>If a sub-sample was collected from a larger material amount, describe how the sub-sample was taken:</b>  	
<b>Observations and remarks:</b>  	
<b>Confirmation</b> I hereby confirm that the sample was selected, taken and packed in accordance with the instructions.	
<b>Date:</b> 200303	<b>Signature:</b> 