



Test Report

Report No.: 809785T3-AB

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Hbk/nmlh

Order no.: 809785

No. of appendices: 3

Assignor: GRID System Aps
Smedevangen 2
3540 Lyngø

Material: Lacquered MDF, 376x376x12. Article name: Shelf/side. Article number: SS.MX

Sampling: The test material was sampled by the assignor and received in cardboard at the Danish Technological Institute 2018-06-07.

Method: ANSI/BIFMA M7.1-2011 (R2016) – Standard test method for determining VOC emissions from office furniture systems, components and seating.

Period: The chamber testing was carried out from 2018-06-18 to 2018-06-25.
The analysis of air samples was carried out from 2018-06-27 to 2018-07-11.

Result: The VOC emissions for the tested sample after 168 hours (7 days) in the chamber were:

	<u>Emission factor (E)</u>	<u>Maximum E Furniture Components*</u>	<u>Evaluation</u>
TVOC _(toluene) :	1.6 mg/m ² h	≤ 0.345 mg/m ² h	Fail
Formaldehyde:	23 µg/m ² h	≤ 42.3 µg/m ² h	Pass
Total aldehydes:	4.0 µmol/m ² h	≤ 2.8 µmol/m ² h	Fail
4-Phenylcyclohexene:	< 1 µg/m ² h	≤ 4.5 µg/m ² h	Pass

Results in detail are shown in Appendices 2 and 3.

*ANSI/BIFMA ANSI/BIFMA X7.1-2011 – Standard for formaldehyde and TVOC emissions of low-emitting office furniture and seating. Table A1.2: Individual furniture Components Maximum Emission Factors at 168 hours.

Storage: The test material will be destroyed after the issue of this test report.

Terms: The testing is only valid for the tested specimen. The test report may only be extracted, if the laboratory has approved the extract.

Date/place: 2018-07-13, Danish Technological Institute, Wood and Biomaterials, Taastrup

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Co-signatory



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Material identification

Sample information given by assignor:

Product: Lacquered MDF, 376x376x12

Article name: Shelf/side

Article number: SS.MX

Production date: 24/5 (2018-05-24)

Sampling date: 29/5 (2018-05-24) – GRID Warehouse, Smedevangen 2, 3540 Lyngø

Sampled by: Søren Ahlfors

Sample handling:

Prior to testing the wrapped samples were stored at the test laboratory at 20-25 °C.

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Emission testing

The test material was unwrapped and placed in the chamber.

Photo of test material in the chamber:



Climate chamber	113 L Polished stainless steel
Temperature	23°C ± 1°C
Relative humidity	50% RH ± 5% RH
Air velocity at the surface of the specimen	0.1 – 0.3 m/s
Air change rate (n)	1.0 h ⁻¹ ± 0.05 h ⁻¹
Material load (L)	1.0 m ² /m ³
Area specific air flow rate (q)	1.0 m ³ /m ² h

The test material was tested in the emission chamber without prior conditioning.

Sampling and analytical methods of air samples:

	Method	Absorbent	Sampling volume	Quantification/Analysis method	Detection limit
VOC and Carcinogens	ISO 16000-6	Tenax TA	4 L	TDS-GC/MS Calibrated with pure reference standards	1 µg/m ³
Formaldehyde and carbonyls	ISO 16000-3	DNPH coated silica gel	60 L	HPLC-DAD Calibrated with pure reference standards	1 µg/m ³

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Emission of volatile organic compounds

The applied test conditions result in an area specific air flow rate of $q = 1.0 \text{ m}^3/\text{m}^2\text{h}$. Thus, the measured concentrations (C) in $\mu\text{g}/\text{m}^3$ of volatile compounds are equal to the surface area specific emission rate i.e. emission factor (E) in $\mu\text{g}/\text{m}^2\text{h}$. The emission factor approach is applied for measurement and evaluation of individual furniture components.

Results from the VOC analysis appears from Table 1.
Method: ISO 16000-6: 2011. Indoor air – Part 6: 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.

Analysis of the air sampled on Tenax was performed at the Wilhelm Klauwitz Institut (WKI) under DAKKS accreditation number D-PL-11140-05-02. Report no. MAIC-2018-2903.

Table 1: Concentrations of volatile organic compounds (VOCs) between n-C6 and n-C16 measured by GC-MS ($\mu\text{g}/\text{m}^2\text{h}$)*

Chemical class/compound name	72 hrs (3 days)				168 hrs (7 days)			
	#1	#2	Mean	% diff	#1	#2	Mean	% diff
Aromatic hydrocarbons								
Toluene	2	< 1	1	200	< 1	< 1	<1	0
Aliphatic hydrocarbons	<1	<1	<1	0	<1	<1	<1	0
Cycloalkanes	<1	<1	<1	0	<1	<1	<1	0
Terpenes	<1	<1	<1	0	<1	<1	<1	0
Alcohols								
n-Butanol	2	2	2	0	< 1	< 1	<1	0
1-Methoxy-2-propanol	14	13	14	7	6	5	6	18
1,2-Propanediol	363	340	352	7	178	155	167	14
Phenol	6	5	6	18	4	4	4	0
2-Ethyl-1-hexanol	2	2	2	0	1	2	2	67
2,4,7,9-Tetramethyl-5-decyne-4,7-diol	41	38	40	8	28	27	28	4
2,6-Di-tert-butyl-4-methylphenol (BHT)	2	2	2	0	1	1	1	0
Glycols/Glycol ethers								
Butylglycol	638	566	602	12	270	244	257	10
DPGMME (mixture of isomers)	796	708	752	12	419	390	405	7
Hexylglycol	5	4	5	22	2	2	2	0
Butyldiglycol	44	40	42	10	23	21	22	9
Diethylene glycol hexyl ether	9	9	9	0	6	6	6	0
Aldehydes								
Benzaldehyde	5	4	5	22	3	3	3	0
2,4,6-Trimethyl benzaldehyde	4	3	4	29	2	2	2	0
Ketones								
Cyclohexanone	9	8	9	12	5	4	5	22
Acetophenone	4	4	4	0	2	2	2	0
2-Hydroxy-2-methylpropiophenone (Darocur 1173)	801	736	769	8	548	503	526	9
Halocarbons	<1	<1	<1	0	<1	<1	<1	0
Acids								
Acetic acid	47	31	39	41	31	34	33	9
Esters								
n-Butyl acetate	11	10	11	10	4	4	4	0
1-Methoxy-2-propyl acetate	149	130	140	14	73	70	72	4
Methyl benzoate (Toluene)	13	12	13	8	6	5	6	18
Ethylhexyl acrylate	17	15	16	13	10	9	10	11

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Emission of volatile organic compounds

Chemical class/compound name	72 hrs (3 days)				168 hrs (7 days)			
	#1	#2	Mean	% diff	#1	#2	Mean	% diff
Dipropylene glycol diacrylate	22	20	21	10	17	15	16	13
Benzoic acid ester (Toluene)	22	16	19	32	16	14	15	13
Others								
alpha-Terpineol	9	8	9	12	5	5	5	0
Triethylamine	49	47	48	4	28	25	27	11
Nitrogenous substance or siloxane (Toluene)	5	4	5	22	3	3	3	0
N-Formylmorpholine (Toluene)	9	8	9	12	6	5	6	18
Nitrogenous substance ? (Toluene)	4	4	4	0	2	2	2	0
Methoxyphenol ? (Toluene)	10	9	10	11	7	7	7	0
Acrylate ? (Toluene)	16	14	15	13	11	10	11	10
Dipropylene glycol butyl ether (mixture of isomers) ?	6	5	6	18	4	4	4	0
Acrylate ? (Toluene)	7	6	7	15	4	4	4	0
Sum other sesquiterpenes:	2	2	2	0	2	2	2	0
Sum unidentified compounds:	9	9	9	0	6	6	6	0
Sum VOC (C6-C16):	3154	2834	2994	11	1733	1595	1664	8
Sum of VOC (C6-C16) as TVOC _{Toluene} according to DIN EN ISO 16000-6:	2821	2524	2673	11	1635	1515	1575	8

* Single substances/volatile compounds were quantified with pure reference standards, and in some cases the substances shown in subscript were used for the quantification.

< 1 Not detected (< 1 µg/m³)

Measured concentrations just above limit of quantification (LOQ) of 1 µg/ m²h will result in higher standard deviation from mean value.

Definitions according to ISO 16000-6:

VOC (C6-C16): Volatile organic compounds, between hexane (C6) and hexadecane (C16)

VVOC (<C6): Very volatile organic compounds, eluting before hexane, not included in TVOC

SVOC (>C16): Semi-volatile organic compounds, eluting after hexadecane, not included in TVOC

TVOC: Total volatile organic compounds is the sum of all VOCs eluting between C6 and C16, quantified as toluene equivalents.

Results from aldehyde analysis are shown in Table 2.

Method: ISO 16000-3: 2011. Indoor Air – Part 3: Determination of formaldehyde and other carbonyl compounds – Active sampling method.

Analysis of the air sampled on DNPH was performed at the Danish Technological Institute under DANAK accreditation number 90. Report no. 820269.

Table 2: ISO 16000-3 Lower aldehydes by HPLC analysis (µg/m²h)*

Compound name	72 hrs (3 days)				168 hrs (7 days)			
	#1	#2	Mean	% diff	#1	#2	Mean	% diff
Formaldehyde	24	24	24	0	23	23	23	0
Acetaldehyde	4.6	4.5	4.6	2	3.6	3.6	3.6	0
Propanal	204	222	213	8	183	190	187	4
Butanal	-	-	-	-	-	-	-	-
Acrolein	-	-	-	-	-	-	-	-

*Limit of detection (LOD) is 0.5 µg/m³ (formaldehyde, acetaldehyde, butanal), 0.8 µg/m³ (propanal) and 3.3 µg/m³ (acrolein)