



Test Report

Report No.: 797543-1_rev1

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Hbk/nmlh

Order no.: 797543

No. of appendices: 3

Assignor: Muuto A/S
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Material: Seating component. Fiber Armchair shell, White.

Sampling: The test material was sampled by the assignor and received in cardboard at the Danish Technological Institute 2018-02-09.

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

Period: The testing was carried out from 2018-02-09 to 2018-02-16.

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) :	0.032 mg/m ² h	≤ 0.345 mg/m ² h	Pass
Formaldehyde:	< 1 µg/m ² h	≤ 42.3 µg/m ² h	Pass
Total aldehydes:	0.03 µmol/m ² h	≤ 2.8 µmol/m ² h	Pass
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.

Note: Revision: Evaluation added to the results table.

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: 2018-03-16, Danish Technological Institute, Wood and Biomaterials, Taastrup. This report replaces previous report dated 2018-03-16.

Signature: Test responsible

Co-signatory

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Material identification

Shell made of PP wood fiber produced by injection moulding.
 Photo of date stamp: February 2018



The PP fiber wood shell is the same material used in all the following fiber seating according to the LEEDv4 test plan dated 13 March 2018 from the Danish Technological Institute.
 The tested seating component represents "Fiber" seating with white pigmentation/light colors.



Fiber Armchair
Wood base



Fiber Side Chair
Sled base



Fiber Armchair
Tube base



Fiber Side Chair
Tube base



Fiber Bar stool w. back
Wood base 75 & 65cm



Fiber Bar stool
Wood base 75 & 65cm



Fiber Stool
Wood base



Fiber Bar stool w. back
Tube base 75 & 65cm



Fiber Bar stool
Tube base 75 & 65cm



Fiber Stool
Tube base

Color variants



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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	1 m ³ 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)	1.05 h ⁻¹ ± 0.05 h ⁻¹
Material load (L)	1.05 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.

Air samples were taken from the climate chamber outlet air with calibrated pumps according to ISO 16000-6 on Tenax tubes (4 L) and ISO 16000-3 on DNPH tubes (60 L).

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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-2018-0891.

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	<1	<1	<1	0	<1	<1	<1	0
Aliphatic hydrocarbons								
2-Methylpentane (3-Methylpentane)	2	2	2.0	0	<1	<1	<1	0
Cycloalkanes	<1	<1	<1	0	<1	<1	<1	0
Terpenes	<1	<1	<1	0	<1	<1	<1	0
Alcohols								
iso-Butanol	2	2	2.0	0	2	2	2.0	0
Glycols/Glycol ethers	<1	<1	<1	0	<1	<1	<1	0
Aldehydes	<1	<1	<1	0	<1	<1	<1	0
n-Nonanal	2	2	2.0	0	<1	<1	<1	0
Ketones	<1	<1	<1	0	<1	<1	<1	0
Halocarbons	<1	<1	<1	0	<1	<1	<1	0
Acids	<1	<1	<1	0	<1	<1	<1	0
Esters	<1	<1	<1	0	<1	<1	<1	0
Benzoic acid ester (Toluene)	3	4	3.5	29	2	2	2.0	0
Others								
Hexamethylcyclotrisiloxane	2	3	2.5	40	2	2	2.0	0
Sum other iso/cyclo-alkanes (VOC, SVOC):	49	47	48.0	4	47	41	44.0	14
TVOC (sum)	58	58	58.0	0	49	45	47.0	9
TVOC (toluene)	34	33	33.5	3	38	25	31.5	41

* 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 $\mu\text{g}/\text{m}^3$)

Measured concentrations just above limit of quantification (LOQ) of 1 $\mu\text{g}/\text{m}^2\text{h}$ 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.

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Emission of volatile organic compounds

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. 799504.

Table 2: ISO 16000-3 Lower aldehydes

Concentrations of formaldehyde and acetaldehyde by HPLC analysis ($\mu\text{g}/\text{m}^2\text{h}$)

Compound name	72 hrs (3 days)				168 hrs (7 days)			
	#1	#2	Mean	% diff	#1	#2	Mean	% diff
Formaldehyde	<1	<1	<1	0	<1	<1	<1	0
Acetaldehyde	1.4	1.4	1.4	0	1.2	1.2	1.2	0

< 1 Not detected ($< 1 \mu\text{g}/\text{m}^3$)

Measured concentrations just above limit of quantification (LOQ) of $1 \mu\text{g}/\text{m}^2\text{h}$ will result in higher standard deviation from mean value.