Test Report

Report Number:
960806-4-M71

DANISH
TECHNOLOGICAL
INSTITUTE

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Init.: HBK/IR
Order no.: 960806
Encl.: 4

Assignor:	HOWE PL Sp. z. o. o., ul. Wyspianskiego 26B/5 , PL 60-751 Poznan, Poland
Material:	40/4 veneer, seat and back, oak lacquered Additional information is given in enclosure A.
Sampling:	The assignor confirms having selected the product on 14 May 2021. The product was forwarded by the assignor and received at Danish Technological Institute on 17 May 2021.
Period:	The test took place from 25 May 2021 to 28 June 2021.
Method:	ANSI/BIFMA M7.1-2011(R2016), Standard Test Method for Determining VOC Emissions From Office Furniture Systems, Components and Seating Additional information is given in enclosure B.
Test results:	The results are shown in detail in enclosure C and D.
Terms:	This test was conducted accredited in accordance with international requirements (ISO/IEC 17025:2017) and in accordance with the General Terms and Conditions of Danish Technological Institute. The test results solely apply to the tested item. This test report may be quoted in extract only if Danish Technological Institute has granted its written consent.
Place:	Danish Technological Institute, Taastrup, Building and Construction
Signature:	This document is only valid with a digital signature from Danish Technological Institute. Date of issue 28 June 2021. Helene Bendstrup Klinke Business Manager

DIGITALLY SIGNED DOCUMENT
28 June 2021
DANISH TECHNOLOGICAL INSTITUTE

ilac-MRA
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TEST Reg.no. 2

Emission testing

Material: 40/4 veneer, seat and back, oak lacquered

Additional test methods:

- ANSI/BIFMA X7.1-2011 Standard for Formaldehyde and TVOC Emissions of Low-emitting Office Furniture and Seating
- ISO 16000-6:2012 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 or MS-FID
- ISO 16000-3:2011 Indoor air - Part 3: Determintation of formaldehyde and other carbonyl compounds - Active sampling method
- CDPH 01350 Ver 1.2 2017 Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers

Sample handling:
Prior to testing the wrapped sample was stored at the test laboratory at 20-25 °C.
The sample was unpacked on 2021-05-25 at 12:00.

Photo of the test material in the chamber:

Climate chamber testing from 2021-05-25 to 2021-06-01

Climate chamber:	1 m³ - 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 (n):	0.66 h^{-1} ± 0.05 h^{-1}
Material load (L):	0.66 m²/m³
Area specific air flow rate (q):	1.0 m³/m²h

Air sampling and analysis

Air samples were taken from the climate chamber outlet air with calibrated pumps, according to the following methods:

Compounds	Method	Absorbent	Sampling volume	Quantification/Analysis method	Detection limit
VOC and carcinogens	ISO 16000-6	Tenax	2-5 L	TDS-GC/MS Calibrated with pure reference standards	1 µg/m³
Formaldehyde and carbonyls	ISO 16000-3	DNPH coated silica gel	50-60 L	HPLC-DAD Calibrated with pure reference standards	1 µg/m³

Analysis of the air sampled on Tenax was performed at the Wilhelm Klauditz Institut (WKI) under DAkkS accreditation number D-PL-11140-05-02. Report no. MAIC-2021-1728.

Analysis of the air sampled on DNPH was performed at the Danish Technological Institute under DANAK accreditation 90. Report no. 984586.

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Results

Emission of volatile organic compounds

Material: 40/4 veneer, seat and back, oak lacquered

The traditional concentration approach (ANSI/BIFMA M7.1 sect. 11.4.1) was applied for emission testing.

*ISO 16000-6 - Volatile organic compounds (VOC)**

Table 1: Emissions of VOC (µg/m³)

		72 hrs (3 days)				168 hrs (7 days)			
Chemical class/compound name	**CAS No.**	**#1**	**#2**	**Mean**	***% diff***	**#1**	**#2**	**Mean**	***% diff***
Aromatic hydrocarbons									
Toluene		17	17	17	*0*	14	14	14	*0*
Ethylbenzene	000100-41-4	3	3	3	*0*	2	2	2	*0*
m,p-Xylene (m-Xylene)	001330-20-7	19	18	19	*5*	12	12	12	*0*
o-Xylene (m-Xylene)	000095-47-6	15	14	15	*7*	8	8	8	*0*
Aliphatic hydrocarbons		< 2	< 2	< 2	*0*	< 2	< 2	< 2	*0*
Cycloalkanes		< 2	< 2	< 2	*0*	< 2	< 2	< 2	*0*
Terpenes		< 2	< 2	< 2	*0*	< 2	< 2	< 2	*0*
Alcohols									
n-Butanol	000071-36-3	5	6	6	*18*	4	4	4	*0*
Glycols/Glycol ethers									
Butylglycol	000111-76-2	8	6	7	*29*	3	3	3	*0*
Aldehydes		< 2	< 2	< 2	*0*	< 2	< 2	< 2	*0*
Ketones									
2-Butanone (MEK)	000078-93-3	18	19	19	*5*	14	14	14	*0*
Cyclohexanone	000108-94-1	1188	1445	1317	*20*	531	539	535	*1*
Halocarbons		< 2	< 2	< 2	*0*	< 2	< 2	< 2	*0*
Acids									
Acetic acid	000064-19-7	58	98	78	*51*	58	67	63	*14*
Esters									
i-Butylacetate	000110-19-0	29	28	29	*4*	13	13	13	*0*
n-Butyl acetate	000123-86-4	183	198	191	*8*	98	99	99	*1*
1-Methoxy-2-propyl acetate	000108-65-6	8	8	8	*0*	3	3	3	*0*
2-Ethylhexanoic acid ester (Methyl dodecanoate)		2	2	2	*0*	< 2	< 2	0	*0*
Octanoic acid ester (Diisobutyl adipate)		5	4	5	*22*	2	2	2	*0*
Decanoic acid ester (Diisobutyl adipate)		3	2	3	*40*	2	2	2	*0*

cont.

		72 hrs (3 days)				168 hrs (7 days)			
Chemical class/compound name	**CAS No.**	**#1**	**#2**	**Mean**	***% diff***	**#1**	**#2**	**Mean**	***% diff***
Others									
Hexamethylcyclotrisiloxane (D3)	000541-05-9	< 2	3	2	*>100*	< 2	< 2	0	*0*
Sums									
TVOC Toluene (ISO 16000-6)		818	979	899	*18*	395	404	400	*2*
Sum VOC (C6-C16)		1561	1871	1716	*18*	764	782	773	*2*

* Single compounds/volatile compounds were quantified with pure reference standards, and in some cases the compounds shown in subscript were used for the quantification. Acetic acid concentrations have higher analytical uncertainty and may be underestimated, since the applied method is not optimal for this compound.

< 2 Not found above reporting limit < 2 µg/m³.
Measured concentrations near limit of quantification (LOQ) of approx. 1 µg/m³ 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.

ISO 16000-3 - VVOC aldehydes

Table 2: Emissions of formaldehyde and carbonyls (µg/m³)

		72 hrs (3 days)				168 hrs (7 days)			
Chemical class/compound name	**CAS No.**	**#1**	**#2**	**Mean**	***% diff***	**#1**	**#2**	**Mean**	***% diff***
Formaldehyde	000050-00-0	8	8	8	*0*	8	8	8	*0*
Acetaldehyde	000075-07-0	< 2	< 2	< 2	*0*	3	3	3	*0*
Propanal	000123-38-6	< 2	< 2	< 2	*0*	< 2	< 2	< 2	*0*
Butanal	000123-72-8	< 2	< 2	< 2	*0*	< 2	< 2	< 2	*0*
Acrolein	000107-02-8	< 3	< 3	< 3	*0*	< 3	< 3	< 3	*0*

Single determination after 7 days.

< 2 or < 3 Not found above reporting limit < 2 µg/m³ or < 3 µg/m³.
Measured concentrations near limit of quantification (LOQ) of approx. 1 µg/m³ will result in higher standard deviation from mean value.

Evaluation of results

According to ANSI/BIFMA M7.1 Table A1.2 and ANSI/BIFMA X7.1 Standard for Formaldehyde and TVOC Emissions from Low-emitting Office Furniture and Seating Table A1.2, the evaluation of indoor air concentrations from individual furniture components must meet the criteria limits for giving LEED EQ Credit 4.5 Low-Emitting Materials, Systems Furniture and Seating. The results are shown in Table 5.

Table 3: VOC emissions of tested sample after 168 hours

	Emission factor (E) of Tested Component	Maximum E Furniture Components* (Open Plan WS)	Maximum E Furniture Components* (Private Office WS)
Formaldehyde (µg/m2h)	8.0	≤ 42,3	≤ 85,1
$TVOC_{(toluene)}$ (µg/m2h)	400	≤ 345	≤ 694
Total aldehydes (µmol/m2h)	0.3	≤ 2,8	≤ 5,7
4-Phenylcyclohexene (µg/m²h)	< 2.0	≤ 4,5	≤ 9,0

* ANSI/BIFMA M7.1 Table A1.2.

Table 4: Estimated concentrations (emission factor) of tested product at 3, 7 and 14 days of target CREL VOCs from Proposition 65 and Table 4-1 in CDPH 01350*.

Please note: The area specific emission rate (in µg/m²h) must be converted to building concentration (in µg/m³) dependent on the material load of the finished product, before comparison with the allowable concentration.

Compound name	CAS No.	$C_{(3\ d)}$ (µg/m²h)	$C_{(7\ d)}$ (µg/m²h)	$C_{(14\ d)}$ (µg/m²h)	Allowable $C_{(14\ d)}$** (µg/m³)
Acetaldehyde	000075-07-0	< 2	3	3	70
Benzene	000071-43-2	-	-	-	2
Carbon disulfide	000075-15-0	-	-	-	400
Carbon tetrachloride	000056-23-5	-	-	-	20
Chlorobenzene	000108-90-7	-	-	-	500
Chloroform	000067-66-3	-	-	-	150
Dichlorobenzene (1.4-)	000106-46-7	-	-	-	400
Dichloroethylene (1.1)	000075-35-4	-	-	-	35
Dimethylformamide (N.N-)	000068-12-2	-	-	-	40
Dioxane (1.4-)	000123-91-1	-	-	-	1500
Epichlorohydrin	000106-89-8	-	-	-	2
Ethylbenzene	000100-41-4	3	2	< 2	1000
Ethylene glycol	000107-21-1	-	-	-	200
Ethylene glycol monoethyl ether	000110-80-5	-	-	-	35
Ethylene glycol monoethyl ether acetate	000111-15-9	-	-	-	150
Ethylene glycol monomethyl ether	000109-86-4	-	-	-	30
Ethylene glycol monomethyl ether acetate	000110-49-6	-	-	-	45
Formaldehyde	000050-00-0	8	8	8	9
Hexane (n-)	000110-54-3	-	-	-	3500
Isophorone	000078-59-1	-	-	-	1000
Isopropanol	000067-63-0	-	-	-	3500
Methyl chloroform	000071-55-6	-	-	-	500
Methylene chloride	001634-04-4	-	-	-	200
Methyl t-butyl ether	000075-09-2	-	-	-	4000
Naphthalene	000091-20-3	-	-	-	5
Phenol	000108-95-2	-	-	-	100
Propylene glycol monomethyl ether	000107-98-2	-	-	-	3500
Styrene	000100-42-5	-	-	-	450
Tetrachloroethylene	000127-18-4	-	-	-	18
Toluene	000108-88-3	17	14	12	150
Trichloroethylene	000079-01-6	-	-	-	300
Vinyl acetate	000108-05-4	-	-	-	100
Xylenes, technical mixture (o.m.p)	000095-47-6 etc.	33	20	13	350

- Not detected
* CDPH 01350 (2017) Standard method for the testing and evaluation of volatile organic chemical emissions from indoor sources using environmental chambers. Version 1.2.
** All maximum allowable concentrations are one-half the corresponding CREL adopted by Office of Environmental Health Hazard Assessment (OEHHA) agency of California Environmental Protection Agency (CalEPA).