REPORT

Contract no.	17687/2025/1 – KW (Translation of the original report of 27.08.2025)	08.09.2025 HAE/KRA
Customer	HASSLACHER Holding GmbH Feistritz 1 9751 Sachsenburg	
Subject	Measurement of the emissions of a sample according to EN 16516	
Date of contract	25.04.2025	
Date of sample delivery	13.05.2025	
Date/Period of service	May 2025 – August 2025	
Period of validity	--	
Pages	13	
Enclosures	--	

1. Contract

On April 25th, 2025 Holzforschung Austria was commissioned with the testing of the VOC, formaldehyde and carbonyl compound emissions of a sample of spruce/(fir) Hasslacher Cross Laminated Timber, 3 layers, according to ÖNORM EN 16516.

Contact person: Mr. DI Wolfgang Bischof

2. Applied standards and guidelines

DIN ISO 16000-6 (2021): 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

ÖNORM EN ISO 16000-9 (2024): Indoor air — Part 9: Determination of the emission of volatile organic compounds from building products and furnishing — Emission test chamber method

ÖNORM EN ISO 16000-11 (2024): Indoor air — Part 11: Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens

ISO 16000-3 (2022): Indoor air — Part 3: Determination of formaldehyde and other carbonyl compounds in indoor and test chamber air — Active sampling method

ÖNORM EN 16516 (2021): Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air

Committee for Health-related Evaluation of Building Products (Ausschuss zur gesundheitlichen Bewertung von Bauprodukten - AgBB) – AgBB 2024; Requirements for the Indoor Air Quality in Buildings: Health-related Evaluation Procedure for Emissions of Volatile Organic Compounds (VVOC, VOC and SVOC) from Building Products (with list of LCI values of 2022)

3. Sample specification

The sample was delivered to Holzforschung Austria on May 13th, 2025. The specimens were packed airtight.

The sample consisted of 2 specimens spruce/(fir) Hasslacher Cross Laminated Timber, with the dimensions of 50 x 50 x 12 cm. The specimens with the product code 10311144120BSP3S and the batch number 35741/3 were taken out of the ongoing production on May 2nd, 2025.

Table 1 shows the properties of the received sample.

Table 1: Samples

HFA sample label	Product designation	Type/series	Sample type	Production date
17687/2025_1	Hasslacher Cross Laminated Timber	NSI 3s 120	spruce/(fir) 3 layers	02.05.2025

4. Test methods

The sample was tested in one of the 0.225 m³ emission chambers of Holzforschung Austria.

One sample specimen was cut (23.5 x 25 cm) so that a loading factor of 0.5 m² emitting surface /m³ emission chamber volume was reached in accordance with EN 16516. With an air exchange rate of 0.5 h^{-1} this resulted in an area specific air flow rate q of 1.0 m³/hm². Therefore, the measured concentration results correspond to the area specific emission rate SER (unit µg/m²h).

The edges of the sample were sealed with self-adhesive aluminium tape, before placing it in the emission chamber (figure 1).

Figure 1: Sample 17687/2025_1 in the 0.225 m³ emission chamber

4.1. Emission chamber testing parameters

Table 2: Emission chamber testing parameters

Parameter	Value	Unit	Tolerance
Temperature	23	°C	± 1
Relative humidity	50	%	± 5
Air exchange rate	0.5	h^{-1}	± 0.015
Loading factor	0.5	m^2/m^3	
Area specific air flow rate q	1.0	m^3/hm^2	
Chamber volume	0.225	m^3	

Temperature and relative humidity conditions were met and recorded continuously during the entire test period.

4.2. Analysis of volatile organic compounds (VOC)

4.2.1. Sampling and analysis

For the sampling of VOC, a defined volume of emission chamber air is drawn through an adsorption tube filled with Tenax TA®, a porous polymer resin based on 2,6-diphenylene oxide. This material is suitable for the adsorption of volatile organic compounds of a chain length between C_6 (n-hexane) and C_{26} (hexacosane). According to the definitions of the WHO[1] this includes both VOC (volatile organic substances with boiling points between 50 °C and 250 °C) and SVOC (semi-volatile organic substances with boiling points between 250 °C and 390 °C).

Subsequent analysis of the Tenax TA®-Tubes is conducted according to ISO 16000-6 and EN 16516 by use of a thermal desorption unit coupled to a gas chromatograph with mass spectrometric detection.

4.2.2. Calibration

Calibration standards, grouped by substance class, were prepared in methanol, injected on Tenax TA® tubes under inert gas conditions and analysed via the above described method. The calibration spans a range of approx. 1 - 250 µg/m for each substance.

4.2.3. Qualitative analysis

Identification of the detected substances is carried out by comparing the obtained chromatograms with mass spectra of commercial spectra libraries and the retention times and fragment ion spectra of commercially available standards.

4.2.4. Quantitative analysis

Substance specific quantification of individual compounds takes place by integrating the peak areas of target and qualifier ions using the above described calibration. Cyclodecane is used as an internal standard.

Substances not included in the calibration are quantified either via related substances or as toluene equivalents.

[1] World Health Organization, WHO (1989) – Indoor Air Quality: Organic Pollutants. Euro reports and studies, 11. Copenhagen, Regional Office for Europe.

4.3. Analysis of formaldehyde (and other carbonyl compounds)

4.3.1. Sampling on 2,4-Dinitrophenylhydrazine (DNPH) and analysis

A defined volume of emission chamber air is drawn through a cartridge containing DNPH. The principle of this procedure is based on the reaction of carbonyl groups with DNPH in acidic media, resulting in the formation of stable hydrazine-derivatives.

Subsequent analysis of the eluted compounds was conducted according to ISO 16000-3 by use of a high pressure liquid chromatography system with a diode array detector (absorption wavelength 360 nm).

4.3.2. Calibration

Commercially available standards were used to prepare a dilution series, which was analysed via the above described method. The calibration spans a range of approx. 1 - 610 µg/m³ for each substance.

4.3.3. Qualitative analysis

Identification of the detected compounds is carried out by comparison of their retention times with those of commercially available standards and information regarding the retention times of the substances on the used Acclaim Carbonyl C18 column.

4.3.4. Quantitative analysis

Substance specific quantification of individual compounds takes place by integrating the peak areas of the substances. To check the detector sensitivity a reference standard mix is analysed before the start of each series of measurements.

5. Results

Categorization of VVOC, VOC and SVOC was performed according to EN 16516 and based on the AgBB guidelines with the following scheme:

- VVOC substances within a retention range of < C_6
- VOC substances within a retention range of C_6-C_{16}
- $TVOC_{spec}$ sum of VOC substances with concentrations ≥5 µg/m³ quantitation by substance specific calibration according to EN 16516 and. AgBB
- TVOC sum of VOC substances with concentrations ≥5 µg/m³ quantitation via toluene equivalents according to EN 16516
- SVOC substances within a retention range of C_{16}-C_{22}
- TSVOC sum of SVOC substances with concentrations ≥5 µg/m³

In compliance with the AgBB guidelines, acetic acid, though eluting before C_6, is also included in the TVOC.
Carcinogenic substances (CARC 1A and CARC 1B, according to regulation (EC) No 1272/2008) are reported and included in the results starting from a concentration of 1 µg/m³.

All results are mean values resulting from repeat determinations (n=2).

As described in section 4 “Test methods” a loading factor of 0.5 m²/m³ was used for testing. With an air exchange rate of 0.5 h^{-1} this resulted in an area specific air flow rate q of 1.0 m³/hm². Therefore, the results shown in 5.1, which are the directly measured concentration results in the chamber air (µg/m³), are corresponding to the area specific emission rate SER (unit µg/m²h) in accordance with EN 16516.

The AgBB guidelines specify that products that can be used for walls, should be tested with a q of 0.5 m³/hm² (corresponding to a loading factor of 1.0 m²/m³). According to EN 16516 a conversion of the measured results in a range of 50% to 200% of the default loading factor is possible, because the specific emission rate stays constant in this range.
To enable the comparison with the specifications of the German AgBB scheme, the results were also calculated for a q=0.5 m³/hm².

These converted results and the list of the “lowest concentrations of interest” (LCI values) of the current AgBB guidelines were used for the calculation of the substance specific R_i:

$$R_i = \frac{c_i}{LCI_i}$$

with

R_i:	substance specific R value
c_i:	determined concentration in µg/m³
LCI_i:	specific LCI value of the substance

For the assessment of the total emissions of the sample on day 28, all substance specific R_i-values are summed up to the actual R value.

$$R = \sum R_i$$

For these calculations the updated LCI values of the AgBB guidelines 2024 were used.

5.1. Results of measurements of VOC, SVOC and Formaldehyde of sample 17687/2025_1 at q=1.0 m³/hm²

Table 3: concentration results VOC, SVOC and Formaldehyde

Substance	CAS - No.	Mean value sample taking day 3		Mean value sample taking day 28		Expanded uncertainty of the method (k=2)
TD/GC/MS analysis in accordance with EN 16516 / ISO 16000-6		**Substance spec. [µg/m³]**	**Toluol equiv. [µg/m³]**	**Substance spec. [µg/m³]**	**Toluol equiv. [µg/m³]**	
Acetic acid	64-19-7	35	<5	23	<5	± 40 %
n-Heptane	142-82-5	10	8	<5	<5	
Hexanal	66-25-1	13	7	11	8	
Alpha-Pinene	80-56-8	21	33	25	39	
Beta-Pinene	127-91-3	13	15	13	15	
Delta-3-Carene	13466-78-9	12	13	11	13	
Limonene	138-86-3	10	11	11	12	
Not identified substance [a]	---	<5	<5	<5	7	
HPLC/DAD analysis in accordance with EN 16516 / ISO 16000-3		**Substance spec. [µg/m³]**		**Substance spec. [µg/m³]**		± 25 %
Formaldehyde*	50-00-0	11		4		
Acetone*	67-64-1	24		13		
Pentanal	110-62-3	6		<5		
TVOCspec		**120**	**---**	**94**	**---**	
TVOC		**---**	**93**	**---**	**94**	
TSVOC		**n.d.**	**n.d.**	**n.d.**	**n.d.**	

* VVOC
a quantified via toluene equivalents

5.2. Converted results of VOC, SVOC and Formaldehyde of sample 17687/2025_1 for a q=0.5 m³/hm²

Table 4: converted results VOC, SVOC and Formaldehyde

Substance	CAS - No.	Mean value sample taking day 3		Mean value sample taking day 28		Expanded uncertainty of the method (k=2)
TD/GC/MS analysis in accordance with EN 16516 / ISO 16000-6		**Substance spec. [µg/m³]**	**Toluol equiv. [µg/m³]**	**Substance spec. [µg/m³]**	**Toluol equiv. [µg/m³]**	
Acetic acid	64-19-7	70	<5	46	<5	± 40 %
n-Heptane	142-82-5	20	16	<5	<5	
Hexanal	66-25-1	26	14	22	16	
Alpha-Pinene	80-56-8	42	66	50	78	
Beta-Pinene	127-91-3	26	30	26	30	
Delta-3-Carene	13466-78-9	24	26	22	26	
Limonene	138-86-3	20	22	22	24	
Not identified substance [a]	---	<5	<5	<5	14	
HPLC/DAD analysis in accordance with EN 16516 / ISO 16000-3		**Substance spec. [µg/m³]**		**Substance spec. [µg/m³]**		± 25 %
Formaldehyde*	50-00-0	22		8		
Acetone*	67-64-1	48		26		
Pentanal	110-62-3	12		8		
TVOCspec		**240**	**---**	**196**	**---**	
TVOC		**---**	**186**	**---**	**196**	
TSVOC		**n.d.**	**n.d.**	**n.d.**	**n.d.**	

* VVOC
a quantified via toluene equivalents

5.3. Calculation of R value for sample 17687/2025_1 at q=0.5 m³/hm²

Table 5: calculation of the R value

Substance	CAS - No	Mean value Sample taking day 28 Substance spec. [µg/m³]	LCI values [µg/m³]	R_i values
Acetic acid	64-19-7	46	1200	0.038
Hexanal	66-25-1	22	900	0.024
Alpha-Pinene	80-56-8	50	2500	0.020
Beta-Pinene	127-91-3	26	1400	0.019
Delta-3-Carene	13466-78-9	22	1500	0.015
Limonene	138-86-3	22	5000	0.004
Formaldehyde*	50-00-0	8	100	0.080
Acetone*	67-64-1	26	120000	0.0002
Pentanal	110-62-3	8	800	0.010
Sum Ri values/R value				**0.21**

* VVOC

6. Result interpretation

Table 6 shows a comparison of the converted results for a q of 0.5 m³/hm² with the specifications of the german AgBB scheme.

Table 6: Comparison AgBB criteria with converted results for a q=0.5 m³/hm²

Categorie	Criteria AgBB day 3	Results day 3	Criteria AgBB day 28	Results day 28
TVOCspec (incl. SVOC with LCI)	≤ 10 000 µg/m³	240 µg/m³	≤ 1 000 µg/m³	196 µg/m³
TSVOC (SVOC without LCI)	-	-	≤ 100 µg/m³	n.d.
Carcinogenic substances	≤ 10 µg/m³ each substance	n.d.	≤ 1 µg/m³ each substance	n.d. (corresponds to < 1 µg/m³)
R value	-	-	≤ 1	0.21
Sum VOC without LCI	-	n.d.	≤ 100 µg/m³	14 µg/m³

n.d. non detectable

The tested sample 17685/2025_1 therefore meets the specifications of the german AgBB scheme at a loading factor of 1.0 m²/m³ (q=0.5 m³/hm²).

7. Storage of samples

Samples will be kept in storage for a period of 3 months after completion of the measurements.

HOLZFORSCHUNG AUSTRIA

Mag. Elisabeth Habla
Authorisation to sign

Mag. Tamo Bachmayer
Technical execution

This report was approved electronically in accordance with an internal HFA process by the designated authorized signatory, traceable and documented.

Accreditation is given for the following procedures.
It is not allowed to use included accreditation marks for own purposes.

Accreditation Mark	*Type of accreditation*	*Procedure/s*
Akkreditierung Austria 0055 ISO/IEC 17025 T	*Testing*	• DIN ISO 16000-6 • ÖNORM EN ISO 16000-9 • ÖNORM EN ISO 16000-11 • DIN ISO 16000-3 • ÖNORM EN 16516

The results and statements given in this document relate only to the tested materials as received, the present information and the state of the art at the time of investigation.

Publication in excerpts is only permitted with the written approval of Holzforschung Austria.

The conformity assessment of the results is subject to the shared-risk approach.