

Tecnalia Research & Innovation  
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ES

## Test Report No. 53732-002 II

<b>Test objective:</b>	<b>Evaluation according to Belgian VOC-Regulation</b>
<b>Sample description by client:</b>	<b>LignumStrand treated</b>
Sampled by:	Tecnalia Research & Innovation
Date of sampling:	15.10.2018
Location of sampling:	at the client
Date of production:	not specified
Date of arrival of sample:	26.10.2018
Test period:	26.10.2018 - 05.12.2018
Date of report:	05.12.2018
Number of pages of report:	19
Testing laboratory:	eco-INSTITUT Germany GmbH, Köln except ‡ subcontracted # outside accreditation
Test objective fulfilled:	✓

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## Sample View

Internal Sample-no.	Description by customer	Condition upon delivery	Type of sample
A002	LignumStrand treated	without objection	Wood based structures (with boric acid)



A002: LignumStrand treated

Remark: The test result referred to the submitted test sample exclusively. The validity of the report is three years at most and will end immediately at any alternation of material composition or in manufacturing process. Publishing in parts requires authorisation.

## Expert Evaluation

The product **LignumStrand treated** has been tested on behalf of **Tecnalia Research & Innovation**.

This evaluation bases on the test criteria of the “**Royal Decree establishing threshold levels for the emissions to the indoor environment from floor coverings, flooring adhesives and surface coatings for wood floorings**” submitted for EU notification by Belgian ministries on the 18th of August 2014.

The results documented in the test report were evaluated as follows.

Test parameter	Result	Requirement	Requirement hold [yes/no]
<b>Emission analysis</b>			
<b>Measurement time: 28 days after test chamber loading</b>			
Total concentration of volatile organic compounds (TVOC <sub>tot</sub> ) <sup>1)</sup>	110 µg/m <sup>3</sup>	≤ 1000 µg/m <sup>3</sup>	yes
Total concentration of semi volatile organic compounds (TSVOC) <sup>1)</sup>	< 5 µg/m <sup>3</sup>	≤ 100 µg/m <sup>3</sup>	yes
Carcinogenic, reproduction toxic and mutagenic compounds, cat. 1A and 1B acc. to Regulation (EC) No. 1272/2008	< 1 µg/m <sup>3</sup>	≤ 1 µg/m <sup>3</sup>	yes
R value (without dimension)	0,24	≤ 1	yes
Toluene	< 1 µg/m <sup>3</sup>	≤ 300 µg/m <sup>3</sup>	yes
Formaldehyde	3 µg/m <sup>3</sup>	≤ 100 µg/m <sup>3</sup>	yes
Acetaldehyde	22 µg/m <sup>3</sup>	≤ 200 µg/m <sup>3</sup>	yes

1) for TVOC and TSVOC only substances ≥ 5 µg/m<sup>3</sup> are considered

## Summary evaluation

The product **LignumStrand treated** meets the requirements of the “Royal Decree establishing threshold levels for the emissions to the indoor environment from floor coverings, flooring adhesives and surface coatings for wood floorings” submitted for EU notification by Belgian ministries on the 18th of August 2014.

Cologne, 05.12.2018

A handwritten signature in black ink, reading "M.-A. Dobaj". The signature is fluid and cursive, with a long, sweeping underline that extends to the right.

Marc-Anton Dobaj, M.Sc. Crystalline Materials  
(Project Manager)

# Laboratory report

## 1 Emission analysis

### Test method

DIN EN 16516 | Testing and evaluation of the release of dangerous substances; determination of emissions into indoor air

### A002, Preparation of test sample

Date: 02.11.2018  
Pre-treatment: not applicable  
Masking of backside: yes  
Masking of edges: yes, 100 %  
Relationship of unmasked edges to surface: not applicable  
Loading: related to area  
Dimensions: 41.8 cm x 41.8 cm

### A002, Test chamber conditions according to DIN ISO 16000-9

Chamber volume: 0.125 m<sup>3</sup>  
Temperature: 23°C ± 1°C  
Relative humidity: 50 % ± 1 %  
Air pressure: normal  
Air: cleaned  
Air change rate: 0.5 h<sup>-1</sup>  
Air velocity: 0.3 m/s  
Loading: 1.4 m<sup>2</sup>/m<sup>3</sup>  
Specific air flow rate: 0.357 m<sup>3</sup>/(m<sup>2</sup> · h)  
Air sampling: 3 days after test chamber loading  
28 days after test chamber loading

### Analytcs

Aldehydes and Ketones | DIN ISO 16000-3  
Limit of determination: 2 µg/m<sup>3</sup>  
Volatile Organic Compounds | DIN ISO 16000-6  
Limit of determination: 1 µg/m<sup>3</sup> (1,4-Cyclohexanedimethanol, Diethylene glycol, 1,4-Butanediol, Linalyl acetate, BIT: 5 µg/m<sup>3</sup>)  
Note for analysis: not specified

## 1.1 Sample A002, Volatile Organic Compounds after 3 days

### Test objective:

Volatile Organic Compounds (VOC), test chamber, air sampling 3 days after test chamber loading

### Test result:

Sample: A002: LignumStrand treated

No.	Substance	CAS No.	RT [min]	Concentration+ Substances ≥ 1 µg/m³ [µg/m³]	Toluene- equivalent Substances ≥ 5 µg/m³ [µg/m³]	CMR Classifi- cation++	LCI Belg.VO [µg/m³]	R-value
<b>2</b>	<b>Aliphatic hydrocarbons (n-, iso- and cyclo-)</b>							
2-2	n-Hexane	110-54-3	4.89	2		Repr. 2	4300	0.00
<b>7</b>	<b>Aldehyde</b>							
7-2	Pentanal	110-62-3	6.36	5	5		800	0.01
7-3	Hexanal	66-25-1	8.39	61	50		900	0.07
7-8	Decanal	112-31-2	17.17	1			900	0.00
7-12	2-Heptenal	18829-55-5	11.93	1			7	0.14
7-13	2-Octenal	2548-87-0	14.16	2			7	0.29
7-17	Furfural	98-01-1	9.18	3		Carc. 2	10	0.30
7-20	Acetaldehyde	75-07-0		47		Carc. 2	1200	0.04
7-21	Propanal	123-38-6		17			750	0.02
7-22	Formaldehyde	50-00-0		4		Carc. 1B Muta. 2	100	0.04
<b>8</b>	<b>Ketones</b>							
8-9	1-Hydroxyacetone (1- Hydroxy-2-propanone)	116-09-6	5.76	3			2100	0.00
8-10	Acetone	67-64-1		11			1200	0.01
<b>9</b>	<b>Acids</b>							
9-1	Acetic acid	64-19-7	4.78	170	75		1200	0.14
9-2	Propionic acid	79-09-4	5.89	5			1500	0.00
9-7	n-Caproic acid (n-Hexa- noic acid)	142-62-1	11.91	3			2100	0.00

**Remark:** The test result referred to the submitted test sample exclusively. The validity of the report is three years at most and will end immediately at any alternation of material composition or in manufacturing process. Publishing in parts requires authorisation.

No.	Substance	CAS No.	RT	Concentration+	Toluene-equivalent	CMR Classification++	LCI Belg.VO	R-value
			[min]	Substances ≥ 1 µg/m³ [µg/m³]	Substances ≥ 5 µg/m³ [µg/m³]		[µg/m³]	
13	<b>Other identified substances in addition to LCI list</b>							
	Methylcyclopentane	96-37-7	5.42	2				
	Hexamethylcyclotrisiloxane (D3)	541-05-9	8.37	1				
	not identified*		14.88	1				
	Ester, probably. Acrylate*		16.95	3				
	Ester, probably. Acrylate*		17.92	3				
	not identified*		17.97	2				

+ identified and calibrated substances, substance specific calculated

++ Classification according to Regulation (EG) N° 1272/2008: Categories Carc. 1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B, TRGS 905: K1A, K1B, M1A, M1B, R1A, R1B; IARC: Group 1 and 2A, DFG MAK-list: Kategorie III1 and III2

\* unidentified substances, calculated as toluene equivalent reported with significant mass fragments as mass-to-charge ratio (m/z)

<b>Carcinogenic, mutagenic and reproductive toxic components*</b>	<b>Concentration after 3 days [µg/m³]</b>	<b>SERa [µg/(m² · h)]</b>
CMR 1: VOC (incl. VVOC and SVOC) with the following categorisations: Regulation (EC) No. 1272/2008: Category Carc. 1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B; TRGS 905: K1, K2, M1, M2, R1, R2; IARC: Group 1 and 2A; DFG (MAK list): Categories III1, III2 (Sum)	< 1	< 0.36
C 1: VOC (incl. VVOC and SVOC) with the following categorisations: Regulation (EG) Nr. 1272/2008: Category Carc. 1A u. 1B (Sum)	< 1	< 0.36

<b>TVOC, Total volatile organic compounds</b>	<b>Concentration after 3 days [µg/m³]</b>	<b>SERa [µg/(m² · h)]</b>
Sum of VOC according to DIN EN 16516	130	47
Sum of VOC according to AgBB 2018 / DIBt	240	87
Sum of VOC according to eco-INSTITUT-Label	270	96
Sum of VOC according to ISO 16000-6	190	68

<b>TSVOC, Total semi volatile organic compounds</b>	<b>Concentration after 3 days [µg/m³]</b>	<b>SERa [µg/(m² · h)]</b>
Sum of SVOC according to DIN EN 16516	< 5	< 1.8
Sum of SVOC without LCI according to AgBB 2018 / DIBt	< 5	< 1.8
Sum of SVOC without LCI according to eco-INSTITUT-Label	< 1	< 0.36
Sum of SVOC with LCI according to AgBB 2018 / DIBt	< 5	< 1.8

<b>TVVOC, Total very volatile organic compounds</b>	<b>Concentration after 3 days [µg/m³]</b>	<b>SERa [µg/(m² · h)]</b>
Sum of VVOC according to AgBB 2018 / DIBt and Belgian regulation	75	27
Sum of VVOC according to eco-INSTITUT-Label	79	28

\*Excluding formaldehyde (Carc. 1B) due to an assumed "practical threshold" under which a significant carcinogenic risk is no longer to be expected (see Federal Institute for Risk Assessment (2006): Toxicological evaluation of formaldehyde and Federal Environment Agency (2016): Reference value for formaldehyde in indoor air). In the case of a toxicological emission assessment, a single-substance analysis of the formaldehyde concentration is necessary. In the opinion of the committee for Indoor Air Guide Values (Ausschuss für Innenraumrichtwerte) of the Federal Environment Agency, the concentration of 0.1 mg formaldehyde/m³ indoor air, based on a measurement period of half an hour, should not be exceeded, also for a short time (Bundesgesundheitsblatt 2016 · 59: 1040-1044 DOI 10.1007 / s00103 -016-2389-5 © Springer-Verlag Berlin Heidelberg 2016).

**Remark:** The test result referred to the submitted test sample exclusively. The validity of the report is three years at most and will end immediately at any alternation of material composition or in manufacturing process. Publishing in parts requires authorisation.



<b>Other sums of VOC</b>	<b>Concentration after 3 days [µg/m³]</b>	<b>SERa [µg/(m² · h)]</b>
VOC without LCI according to AgBB/DIBt and Belgian regulation (Sum)	< 5	< 1.8
VOC without LCI according to eco-INSTITUT-Label (Sum)	12	4.3
CMR 2: VOC (incl. VVOC and SVOC) with the following categorisations: Regulation (EC) No. 1272/2008: Category Carc. 2, Muta. 2, Repr. 2; TRGS 905: K3; IARC: Group 2B; DFG (MAK list): Category III3 (Sum)	56	20
Sensitising compounds with the following categorisations: DFG (MAK list): Category IV, German Federal Institute for Risk Assessment lists: Cat A, TRGS 907 (Sum)	10	3.6
Bicyclic Terpenes (sum)	< 1	< 0.36
C9 - C14: Alkanes / Isoalkanes as dekane-equivalent (Sum)	< 1	< 0.36
C4 - C11 Aldehydes, acyclic, aliphatic (Sum)	70	25
C9 - C15 Alkylated benzenes (Sum)	< 1	< 0.36
Cresols (Sum)	< 1	< 0.36

<b>Risk value for assessment of LCI</b>	<b>R-value</b>
R-value according to eco-INSTITUT-Label	0.81
R-value according to AgBB 2018 / DIBt	0.29
R-value according to Belgian regulation	0.29
R-value according to AFSSET	3.15

**Note:**

Due to different requirements in the respective guidelines, the calculation of TVOC, TVVOC, TSVOC and R-value may result in different values.

For short-chain carbonyl compounds (C<sub>1</sub>-C<sub>5</sub>), which are quantified by HPLC according to DIN ISO 16000-3, no indication of the toluene equivalent is specified. Therefore, these substances are considered with their substance-specific Quantification in the TVVOC acc. DIN EN 16516.

**Remark:** The test result referred to the submitted test sample exclusively. The validity of the report is three years at most and will end immediately at any alternation of material composition or in manufacturing process. Publishing in parts requires authorisation.

## 1.2 Sample A002, Volatile Organic Compounds after 28 days

### Test objective:

Volatile Organic Compounds (VOC), test chamber, air sampling 28 days after test chamber loading

### Test result:

Sample: A002: LignumStrand treated

No.	Substance	CAS No.	RT [min]	Concentration+ Substances ≥ 1 µg/m³ [µg/m³]	Toluene-equivalent Substances ≥ 5 µg/m³ [µg/m³]	CMR Classification++	LCI Belg.VO [µg/m³]	R-value
<b>7</b>	<b>Aldehyde</b>							
7-2	Pentanal	110-62-3		5			800	0.01
7-3	Hexanal	66-25-1	8.36	47	39		900	0.05
7-13	2-Octenal	2548-87-0	14.15	1			7	0.14
7-17	Furfural	98-01-1	9.17	2		Carc. 2	10	0.20
7-20	Acetaldehyde	75-07-0		22		Carc. 2	1200	0.02
7-21	Propanal	123-38-6		14			750	0.02
7-22	Formaldehyde	50-00-0		3		Carc. 1B Muta. 2	100	0.03
<b>8</b>	<b>Ketones</b>							
8-10	Acetone	67-64-1		7			1200	0.01
<b>9</b>	<b>Acids</b>							
9-1	Acetic acid	64-19-7	4.80	170	73		1200	0.14
9-2	Propionic acid	79-09-4	5.86	3			1500	0.00
9-7	n-Caproic acid (n-Hexanoic acid)	142-62-1	11.88	2			2100	0.00
<b>13</b>	<b>Other identified substances in addition to LCI list</b>							
	Hexamethylcyclotrisiloxane (D3)	541-05-9	8.35	1				

+ identified and calibrated substances, substance specific calculated

++ Classification according to Regulation (EG) N° 1272/2008: Categories Carc. 1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B, TRGS 905: K1A, K1B, M1A, M1B, R1A, R1B; IARC: Group 1 and 2A, DFG MAK-list: Kategorie III1 and III2

\* unidentified substances, calculated as toluene equivalent reported with significant mass fragments as mass-to-charge ratio (m/z)

**Remark:** The test result referred to the submitted test sample exclusively. The validity of the report is three years at most and will end immediately at any alternation of material composition or in manufacturing process. Publishing in parts requires authorisation.

<b>Carcinogenic, mutagenic and reproductive toxic components*</b>	<b>Concentration after 28 days [µg/m³]</b>	<b>SERa [µg/(m² · h)]</b>
CMR 1: VOC (incl. VVOC and SVOC) with the following categorisations: Regulation (EC) No. 1272/2008: Category Carc. 1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B; TRGS 905: K1, K2, M1, M2, R1, R2; IARC: Group 1 and 2A; DFG (MAK list): Categories III1, III2 (Sum)	<b>&lt; 1</b>	<b>&lt; 0.36</b>
C 1: VOC (incl. VVOC and SVOC) with the following categorisations: Regulation (EG) Nr. 1272/2008: Category Carc. 1A u. 1B (Sum)	<b>&lt; 1</b>	<b>&lt; 0.36</b>

<b>TVOC, Total volatile organic compounds</b>	<b>Concentration after 28 days [µg/m³]</b>	<b>SERa [µg/(m² · h)]</b>
Sum of VOC according to DIN EN 16516	<b>110</b>	<b>40</b>
Sum of VOC according to AgBB 2018 / DIBt	<b>220</b>	<b>80</b>
Sum of VOC according to eco-INSTITUT-Label	<b>230</b>	<b>83</b>
Sum of VOC according to ISO 16000-6	<b>110</b>	<b>40</b>

<b>TSVOC, Total semi volatile organic compounds</b>	<b>Concentration after 28 days [µg/m³]</b>	<b>SERa [µg/(m² · h)]</b>
Sum of SVOC according to DIN EN 16516	<b>&lt; 5</b>	<b>&lt; 1.8</b>
Sum of SVOC without LCI according to AgBB 2018 / DIBt	<b>&lt; 5</b>	<b>&lt; 1.8</b>
Sum of SVOC without LCI according to eco-INSTITUT-Label	<b>&lt; 1</b>	<b>&lt; 0.36</b>
Sum of SVOC with LCI according to AgBB 2018 / DIBt	<b>&lt; 5</b>	<b>&lt; 1.8</b>

<b>TVVOC, Total very volatile organic compounds</b>	<b>Concentration after 28 days [µg/m³]</b>	<b>SERa [µg/(m² · h)]</b>
Sum of VVOC according to AgBB 2018 / DIBt and Belgian regulation	<b>43</b>	<b>15</b>
Sum of VVOC according to eco-INSTITUT-Label	<b>46</b>	<b>17</b>

\*Excluding formaldehyde (Carc. 1B) due to an assumed "practical threshold" under which a significant carcinogenic risk is no longer to be expected (see Federal Institute for Risk Assessment (2006): Toxicological evaluation of formaldehyde and Federal Environment Agency (2016): Reference value for formaldehyde in indoor air). In the case of a toxicological emission assessment, a single-substance analysis of the formaldehyde concentration is necessary. In the opinion of the committee for Indoor Air Guide Values (Ausschuss für Innenraumrichtwerte) of the Federal Environment Agency, the concentration of 0.1 mg formaldehyde/m³ indoor air, based on a measurement period of half an hour, should not be exceeded, also for a short time (Bundesgesundheitsblatt 2016 · 59: 1040-1044 DOI 10.1007 / s00103 -016-2389-5 © Springer-Verlag Berlin Heidelberg 2016).

**Remark:** The test result referred to the submitted test sample exclusively. The validity of the report is three years at most and will end immediately at any alternation of material composition or in manufacturing process. Publishing in parts requires authorisation.

Other sums of VOC	Concentration after 28 days [µg/m³]	SERa [µg/(m² · h)]
VOC without LCI according to AgBB/DIBt and Belgian regulation (Sum)	< 5	< 1.8
VOC without LCI according to eco-INSTITUT-Label (Sum)	1	0.36
CMR 2: VOC (incl. VVOC and SVOC) with the following categorisations: Regulation (EC) No. 1272/2008: Category Carc. 2, Muta. 2, Repr. 2; TRGS 905: K3; IARC: Group 2B; DFG (MAK list): Category III3 (Sum)	27	9.7
Sensitising compounds with the following categorisations: DFG (MAK list): Category IV, German Federal Institute for Risk Assessment lists: Cat A, TRGS 907 (Sum)	8	2.9
Bicyclic Terpenes	< 1	< 0.36
C9 - C14: Alkanes / Isoalkanes as dekane-equivalent (Sum)	< 1	< 0.36
C4 - C11 Aldehydes, acyclic, aliphatic (Sum)	53	19
C9 - C15 Alkylated benzenes (Sum)	< 1	< 0.36
Cresols (Sum)	< 1	< 0.36

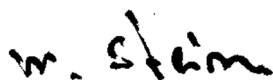
Risk value for assessment of LCI	R-value
R-value according to eco-INSTITUT-Label	0.53
R-value according to AgBB 2018 / DIBt	0.24
R-value according to Belgian regulation	0.24
R-value according to AFSSET	2.62

Note:

Due to different requirements in the respective guidelines, the calculation of TVOC, TVVOC, TSVOC and R-value may result in different values.

For short-chain carbonyl compounds (C<sub>1</sub>-C<sub>5</sub>), which are quantified by HPLC according to DIN ISO 16000-3, no indication of the toluene equivalent is specified. Therefore, these substances are considered with their substance-specific Quantification in the TVVOC acc. DIN EN 16516

Cologne, 05.12.2018



Michael Stein, Dipl.-Chem.  
 (Deputy Technical Manager)

Remark: The test result referred to the submitted test sample exclusively. The validity of the report is three years at most and will end immediately at any alternation of material composition or in manufacturing process. Publishing in parts requires authorisation.

# Appendix

## I Sampling sheet

Produktprüfung Product testing Zertifizierung Certification Beratung Consulting	53732-001-002	
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### Sampling Sheet\*

<b>Testing laboratory</b> eco-INSTITUT Germany GmbH Schanzenstr. 6-20, D-51063 Cologne Germany Tel. +49 (0)221 - 931245-0 Fax +49 (0)221 - 931245-33	<b>Sampler</b> Same as manufacturer. (Name, Company, Phone number)
<b>Name of manufacturer / distributor at place of sampling</b> (Address / Stamp) TABSAL CIF: B71307292 Paraje cerradora s/n 31840 Uharte-Arakil (Navarra) Spain	<b>Customer/ Invoice recipient</b> (if different from manufacturer) TECNALIA CIF: G48975767 Parque Científico y Tecnológico de Bizkaia C\Geldo, Edificio 700 E-48160 Derio (Bizkaia) Spain

<b>Product name</b> LignumStrand LignumStrand treated	<b>Product type</b> Wood based structures (e.q. parquet, floor covering)
<b>Model / programme / series</b> --	<b>Batch</b> --
<b>Article number</b> --	<b>Production date of batch</b> --

<b>Samples are taken from</b> <input checked="" type="checkbox"/> current production <input type="checkbox"/> storage	<b>Sampling date</b> 15.10.18
<b>Storage location before sampling</b> <input checked="" type="checkbox"/> in production <input type="checkbox"/> storage <input type="checkbox"/> other	<b>Storage conditions before sampling</b> <input type="checkbox"/> open <input checked="" type="checkbox"/> packaged
<b>Storage location:</b> Manufacturer location	<b>Packaging material:</b> Plastic

<b>Special features</b> (possible negative effects through emissions at place of sampling (e.g. benzine, exhaust fumes), unclarities, questions etc.)	Treated sample is the one labelled "bórico" Non treated sample is the one labelled "no bórico" Possible uses walls and ceilings (use worst case)
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<b>Validation</b> Hereby the signer affirms the accuracy of the above-mentioned statements. The sample was chosen, sampled and packaged according to the sampling guidelines.	
Date: 22.10.18	Signature: (Company stamp)  Inspiring Business Fundación TECNALIA Research & Innovation

\* Please take one sampling sheet for each sample! The sampling instruction must be strictly maintained.

<b>Order</b> (Please insert quote number, or - if not available, please enter the desired analysis)	<b>Reference from Tecnalia:</b> Test required: According to email attached (02179+02181+02182+02183+02178) Official order: To be provided. It will include the reference number
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**Remark:** The test result referred to the submitted test sample exclusively. The validity of the report is three years at most and will end immediately at any alternation of material composition or in manufacturing process. Publishing in parts requires authorisation.

## II Definition of terms

VOC (volatile organic compounds)	All individual compounds with a concentration $\geq 1 \mu\text{g}/\text{m}^3$ in the retention range C <sub>6</sub> (n-Hexane) to C <sub>16</sub> (n-Hexadecane)
TVOC	Total volatile organic compounds
TVOC according to DIN EN 16516	Sum of all VOC $\geq 5 \mu\text{g}/\text{m}^3$ in the retention range C <sub>6</sub> to C <sub>16</sub> , calculated as toluene equivalent
TVOC according to AgBB/DIBt	Sum of all identified and calibrated VOC $\geq 5 \mu\text{g}/\text{m}^3$ , SVOC $\geq 5 \mu\text{g}/\text{m}^3$ with LCI and not calibrated VOC $\geq 5 \mu\text{g}/\text{m}^3$ calculated as toluene equivalent
TVOC according to eco-INSTITUT-Label	Sum of all identified and calibrated VOC $\geq 1 \mu\text{g}/\text{m}^3$ , SVOC $\geq 5 \mu\text{g}/\text{m}^3$ with LCI and not calibrated VOC $\geq 1 \mu\text{g}/\text{m}^3$ calculated as toluene equivalent
TVOC according to ISO 16000-6	Total area of chromatogram in the retention range C <sub>6</sub> to C <sub>16</sub> , calculated as toluene equivalent
TVOC without LCI according to AgBB/DIBt and Belgian regulation	Sum of all VOC without NIK $\geq 5 \mu\text{g}/\text{m}^3$ in the retention range C <sub>6</sub> to C <sub>16</sub>
TVOC without LCI according to eco-INSTITUT-Label	Sum of all VOC without NIK $\geq 1 \mu\text{g}/\text{m}^3$ in the retention range C <sub>6</sub> to C <sub>16</sub>
CMR-VOC (carcinogenic, mutagenic, reproduction-toxic VOC, VVOC and SVOC)	All individual substances with the following categories: Regulation (EC) No. 1272/2008: Category Car.1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B TRGS 905: K1A, K1B, M1A, M1B, R1A, R1B IARC: Group 1 and 2A DFG (MAK lists): Category III1 and III2
VVOC (very volatile organic compounds)	All individual substances with a concentration $\geq 1 \mu\text{g}/\text{m}^3$ in the retention range $< C_6$
TVVOC	Total very volatile organic compounds
TVVOC according to AgBB/DIBt and Belgian regulation	Sum of all identified and calibrated VVOC $\geq 5 \mu\text{g}/\text{m}^3$ with LCI
TVVOC according to eco-INSTITUT-Label	Sum of all identified and calibrated VVOC $\geq 1 \mu\text{g}/\text{m}^3$ with LCI
SVOC (semi volatile organic compounds)	All individual substances $\geq 1 \mu\text{g}/\text{m}^3$ in the retention range C <sub>16</sub> to C <sub>22</sub>
TSVOC	Total semi volatile organic compounds
TSVOC according to DIN EN 16516	Sum of all SVOC in the retention range C <sub>16</sub> to C <sub>22</sub> , calculated as toluene equivalent
TSVOC without LCI according to AgBB/DIBt	Sum of all SVOC $\geq 5 \mu\text{g}/\text{m}^3$ without LCI
TSVOC without LCI according to eco-INSTITUT-Label	Sum of all SVOC $\geq 1 \mu\text{g}/\text{m}^3$ without LCI
TSVOC with LCI according to AgBB/DIBt	Sum of all identified and calibrated SVOC $\geq 5 \mu\text{g}/\text{m}^3$ with LCI
SER	Specific emission rate (see appendix IV)

LCI value	Lowest Concentration of Interest; calculated value for the evaluation of VOC, established by the Committee for Health-related Evaluation of Building Products (Ausschuss zur gesundheitlichen Bewertung von Bauprodukten - AgBB)
R value	The quotient of the concentration and the LCI value is generated for every substance which is detected in the test chamber air. The sum of the calculated quotients results in the R value.
R value according to eco-INSTITUT-Label	R value for all identified and calibrated VOC $\geq 1 \mu\text{g}/\text{m}^3$ with LCI, established by the AgBB in 2018
R value according to AgBB 2018/DIBt	R value for all identified and calibrated VOC $\geq 5 \mu\text{g}/\text{m}^3$ with LCI, established by the AgBB in 2018
R value according to Belgian regulation	R value for all identified and calibrated VOC $\geq 5 \mu\text{g}/\text{m}^3$ with LCI, established by the Belgian regulation
R value according to AFSSET	R value for all identified and calibrated VOC $\geq 5 \mu\text{g}/\text{m}^3$ with LCI, established by ANSES (French National Agency on Food Safety, Environment, and Workplace Security)
RT (retention time)	Time for a particular analyte to pass through the system (from the column inlet to the detector)
CAS No. (Chemical Abstracts Service)	International unique numerical identifier for a chemical substance
Toluene equivalent	Concentration, calculated as toluene equivalent



### III List of calibrated Volatile Organic Compounds (VOC)

#### Aromatic hydrocarbons

Toluene  
Ethylbenzene  
p-Xylene  
m-Xylene  
o-Xylene  
Isopropylbenzene  
n-Propylbenzene  
1,3,5-Trimethylbenzene  
1,2,4-Trimethylbenzene  
1,2,3-Trimethylbenzene  
2-Ethyltoluene  
1-Isopropyl-2-methylbenzene  
1-Isopropyl-4-methylbenzene  
1,2,4,5-Tetramethylbenzene  
n-Butylbenzene  
1,3-Diisopropylbenzene  
1,4-Diisopropylbenzene  
Phenyltoluene  
1-Phenyldecane<sup>2</sup>  
1-Phenylundecane<sup>2</sup>  
4-Phenylcyclohexene  
Styrene  
β-Methylstyrene  
Phenylacetylene  
2-Phenylpropene  
Vinyltoluene  
Naphthalene  
Indene  
Benzene  
1-Methylnaphthalene  
2-Methylnaphthalene  
1,4-Dimethylnaphthalene  
3-Propyltoluene  
2-Propyltoluene

#### Saturated aliphatic substances

2-Methylpentane<sup>1</sup>  
3-Methylpentane<sup>1</sup>  
n-Hexane  
Cyclohexane  
Methylcyclohexane  
n-Heptane  
n-Octane  
n-Nonane  
n-Decane  
n-Undecane  
n-Dodecane  
n-Tridecane  
n-Tetradecane  
n-Pentadecane  
n-Hexadecane  
Methylcyclopentane  
1,4-Dimethylcyclohexane  
2,2,4,4,6,6-Pentamethylheptane

#### Terpenes

δ-3-Carene  
α-Pinene  
β-Pinene

Limonene  
Longifolene  
β-Caryophyllene  
α-Phellandrene  
Myrcene  
Camphene  
α-Terpinene  
Longipinene  
trans-β-Farnesene  
cis-β-Farnesene  
Isolongifolene

#### Aliphatic alcohols and ether

1-Propanol<sup>1</sup>  
2-Propanol<sup>1</sup>  
1-Butanol  
1-Pentanol  
1-Hexanol  
tert-Butanol  
Cyclohexanol  
2-Ethyl-1-hexanol  
2-Methyl-1-propanol  
1-Octanol  
4-Hydroxy-4-methyl-2-pentanone  
1-Heptanol  
1-Nonanol  
1-Decanol  
1,4-Cyclohexanedimethanol

#### Aromatic alcohols (phenoles)

Phenol  
BHT (2,6-Di-tert-butyl-4-methylphenol)  
Benzyl alcohol  
Cresols

#### Glycols, Glycol ether, Glycol ester

Propyleneglycol (1,2-Dihydroxypropane)  
Ethleneglycol (Ethandiol)  
Ethylene glycol monobutyl ether  
Diethylene glycol  
Diethylene glycol-monobutyl ether  
2-Phenoxyethanol  
Ethylene carbonate  
1-Methoxy-2-propanol  
2-Methoxy-1-propanol  
2-Methoxy-1-propyl acetate  
Texanol  
Glycolic acid butylester  
Butyl diglycol acetate  
Dipropylene glycol monomethyl ether  
2-Methoxyethanol  
2-Ethoxyethanol  
2-Propoxyethanol  
2-Methylethoxyethanol  
2-Hexoxyethanol  
1,2-Dimethoxyethane  
1,2-Diethoxyethane  
2-Methoxyethyl acetate  
2-Ethoxyethyl acetate  
2-(2-Hexoxyethoxy)ethanol  
1-Methoxy-2-(2-methoxy-ethoxy)ethane  
Propylene glycol diacetate

Dipropylene glycol  
Dipropylene glycol monomethylether acetate  
Dipropylene glycol n-butylether  
Dipropylene glycol n-propyl ether  
Di(propylene glycol) tert-butylether  
1,4-Butanediol  
Tri(propylene glycol) methyl ether  
Triethylene glycol dimethyl ether  
Propylene glycol dimethyl ether  
TXIB (Texanol isobutyrate)  
Ethylidiglycol  
Dipropylene glycol dimethylether  
Propylene carbonate  
Hexleneglycol  
3-Methoxy-1-butanol  
Propylene glycol n-propyl ether  
Propylene glycol n-butyl ether  
Diethylene glycol phenyl ether  
Neopentyl glycol  
Diethylene glycol methyl ether  
1-Ethoxy-2-propanol  
tert-Butoxy-2-propanol  
2-Butoxy ethyl acetate

#### Aldehydes

Butanal<sup>1,3</sup>  
3-Methyl-1-butanal  
Pentanal<sup>3</sup>  
Hexanal  
Heptanal  
2-Ethylhexanal  
Octanal  
Nonanal  
Decanal  
2-Butenal<sup>3</sup>  
2-Pentenal<sup>3</sup>  
2-Hexenal  
2-Heptenal  
2-Octenal  
2-Nonenal  
2-Decenal  
2-Undecenal  
Furfural  
Ethanediol (Glyoxal)<sup>1,3</sup>  
Glutaraldehyde  
Benzaldehyde  
Acetaldehyde<sup>1,3</sup>  
Formaldehyde<sup>1,3</sup>  
Propanal<sup>1,3</sup>  
Propenal<sup>1,3</sup>  
Isobutenal<sup>3</sup>

#### Ketones

Ethylmethylketone<sup>3</sup>  
3-Methyl-2-butanone  
Methylisobutylketone  
Cyclopentanone  
Cyclohexanone  
Acetone<sup>1,3</sup>  
2-Methylcyclopentanone  
2-Methylcyclohexanone



Acetophenone	Glutaric acid dimethylester	Dodecamethylcyclohexasiloxane
1-Hydroxyacetone	Hexandioldiacrylate	Tetrahydrofuran (THF)
2-Heptanon	Maleic acid dibutylester	1-Decene
<b>Acids</b>	Butyrolactone	Benzothiazole
Acetic acid	Glutaric acid diisobutylester	1-Octene
Propionic acid	Succinic acid diisobutylester	2-Pentylfuran
Isobutyric acid	Dimethylphthalate	2-Methylfuran
Butyric acid	Diethylphthalate <sup>2</sup>	Isophorone
Pivalic acid	Dipropylphthalate <sup>2</sup>	Tetramethyl succinonitrile
Valeric acid	Dibutylphthalate <sup>2</sup>	Dimethylformamide (DMF)
Caproic acid	Diisobutylphthalate <sup>2</sup>	Tributyl phosphate
Heptanoic acid	Dipropylene glycol diacrylate	N-Ethyl-2-pyrrolidone
Octanoic acid		Aniline
2-Ethylhexanoic acid		4-Vinylcyclohexene
	<b>Chlorinated hydrocarbons</b>	Dimethoxymethane
	Tetrachlorethene	Dichlormethane
	1,1,1-Trichlorethane	Carbon tetrachloride
	Trichlorethene	trans-Decahydronaphthalene
	1,4-Dichlorbenzene	cis-Decahydronaphthalene
	Chlorobenzene	Linalyl acetate
		Chloroform
	<b>Others</b>	Chloroprene (monomer)
	1,4-Dioxane	Acetamide
	Caprolactam	Formamide
	N-Methyl-2-pyrrolidone	1,3-Dichlor-2-propanol
	Octamethylcyclotetrasiloxane	2-n-Octyl-4-isothiazolin-3-one (OIT)
	Hexamethylcyclotrisiloxane	1,2-Benzylisothiazolin-3-one (BIT)
	Methenamine	
	2-Butanonoxime	
	Triethyl phosphate	
	Tributyl phosphate	
	5-Chlor-2-methyl-4-isothiazolin-3-one (CIT)	
	2-Methyl-4-isothiazolin-3-one (MIT)	
	Triethylamine	
	Decamethylcyclopentasiloxane	

- 1 VVOC
- 2 SVOC
- 3 Analysis according to DIN ISO 16000-3

## IV Commentary on emission analysis

### Test method

Measurement of the volatile organic compounds takes place in the test chamber in conditions similar to those applying in practice. Standardized test conditions are defined for the test chamber regarding loading, air exchange, relative humidity, temperature and incoming air, based on the type of test specimen and the required guideline. These conditions and the underlying standards are to be found in the section on test methods in the laboratory report.

Air samples are taken from the test chamber at defined points in time during the continuously running test. To this end, approximately 5 L of air are collected from the test chamber with an air flow rate of 100 mL/min for Tenax and approx. 100 L with an air flow rate of 0.8 L/min for DNPH (dinitrophenylhydrazine).

After thermal desorption, the substances adsorbed on Tenax are analysed using gas chromatographic separation and mass spectrometric determination. The gas chromatographic separation is performed with a slightly polar capillary column of 60 m in length.

The substances derivatized with DNPH for the determination of formaldehyde and other short-chain carbonyl compounds (C1 - C6) are analysed using high-performance liquid chromatography.

Over 200 compounds, including volatile organic compounds (C6 - C16), semi-volatile organic compounds (C16 - C22) and – insofar as possible with this method – also very volatile organic compounds (less than C6) are determined and quantified individually.

All other substances – insofar as is possible – are identified through comparison with a library of spectra. The quantification of these substances and non-identified substances is performed through a comparison of their signal area with the signal of the internal standard d8 toluene. As far as possible, identification and quantification limit of any substance shall be 1 µg per m<sup>3</sup> for substances adsorbed on Tenax and 2 µg/m<sup>3</sup> for DNPH-derivatized substances (limit of quantification).

### Quality assurance

The eco-INSTITUT Germany GmbH is granted flexible scope of accreditation pursuant to DIN EN ISO/IEC 17025. The accreditation covers the analytical determination of all volatile organic compounds, including the test chamber method.

In each analysis the analytical system is checked using an external standard based on the specifications in standard DIN EN 16516. The stability of the analytical systems is documented based on the test standard using control charts.

Laboratory performance is assessed at least once a year in inter-laboratory comparisons by comparing the results with those obtained by other laboratories for identical samples.

A blank is run prior to introducing the test specimen into the test chamber to check for the possible presence of volatile organic compounds.

## V Explanation of Specific Emission Rate SER

Emission measurements are accomplished in test chambers under defined physical conditions (temperature, relative humidity, room loading, air change rate etc.).

Test chamber measurement results are directly comparable only if the investigations were accomplished under the same basic conditions.

If the differences of the physical conditions refer only to the change of air rate and/or the loading, the "SER" or "specific emission rate" can be used for comparability of the measurement results. The SER indicates how many volatile organic compounds (VOC) are released by the sample for each material unit and hour (h).

The SER can be calculated using the formula below for each proven individual component of the VOC from the data in the test report.

As material units the following are applicable:

l = unit of length (m)	relation between emission and length
a = unit area (m <sup>2</sup> )	relation between emission and surface
v = unit volume (m <sup>3</sup> )	relation between emission and volume
u = piece unit (unit = piece)	relation between emission and complete unit

From this the different dimensions for SER result:

length-specific	SER <sub>l</sub> in µg/(m·h)
surface-specific	SER <sub>a</sub> in µg/(m <sup>2</sup> ·h)
volume-specific	SER <sub>v</sub> in µg/(m <sup>3</sup> ·h)
unit specific	SER <sub>u</sub> in µg/(u·h)

SER thus represents a product specific rate, which describes the mass of the volatile organic compound, which is emitted by the product per time unit at a certain time after beginning of the examination.

$$\text{SER} = q \cdot c$$

- q specific air flow rate (quotient from change of air rate and loading)  
c concentration of the measured substance(s)

The result can be indicated in milligrams (mg) in place of micro grams (µg), whereby 1 mg = 1000 µg.