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## VOC EMISSION TEST REPORT

### Indoor Air Comfort<sup>®</sup>

14 August 2018

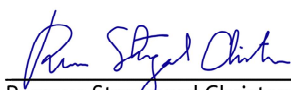
#### 1 Sample Information

Sample name	Space cabinet
Batch no.	820 1143 0010
Production date	14/05/2018
Product type	Storage cabinet
Sample reception	17/05/2018

#### 2 Brief Evaluation of the Results

Regulation or protocol	Conclusion	Version of regulation or protocol
Indoor Air Comfort <sup>®</sup>	Pass	Indoor Air Comfort 6.0 of February 2017
EN 717-1 <sup>s</sup>	E1	2004

Full details based on the testing and direct comparison with limit values are available in the following pages



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### 3 Applied Test Methods

#### 3.1 General Test References

Regulation, protocol or standard	Version	Reporting limit VOC [ $\mu\text{g}/\text{m}^3$ ]	Calculation of TVOC	Combined uncertainty <sup>a</sup> [RSD(%)]
EN 16516	October 2017	5	Toluene equivalents	22%
ISO 16000 -3 -6 -9 -11	2006-2011 depending on part	2	Toluene equivalents	22%
ASTM D5116-10	2010	-	-	-
Specifications Indoor Air Comfort	6.0 of February 2017	5	Toluene equivalents	22%
EN 717-1 <sup>s</sup>	2004	-	(Formaldehyde only)	22%

#### 3.2 Specific Laboratory Sampling and Analyses

Procedure	External Method	Internal SOP	Quantification limit / sampling volume	Analytical principle	Uncertainty <sup>a</sup> [RSD(%)]
Sample preparation	ISO 16000-11:2006, EN16402:2013	71M549810	-	-	-
Emission chamber testing	ISO 16000-9:2006, EN 16516:2017	71M549811	-	Chamber and air control	-
Sampling of VOC	ISO 16000-6:2011, EN 16516:2017	71M549812	5 L	Tenax TA	-
Analysis of VOC	ISO 16000-6:2011, EN 16516:2017	71M542808B	1 $\mu\text{g}/\text{m}^3$	ATD-GC/MS	10%
Sampling of aldehydes	ISO 16000-3:2011, EN 16516:2017	71M549812	35 L	DNPH	-
Analysis of aldehydes	ISO 16000-3:2011, EN 717-1, EN 16516:2017	71M548400	3-6 $\mu\text{g}/\text{m}^3$	HPLC-UV	10%
Sampling of phthalates	ISO 16200-1, MEL-09, OSHA CSI	71M549812	60 L	XAD-2	-
Analysis of phthalates*	CPSC-CH-C1001-09.3 (2010)	71M546060	0.6 $\mu\text{g}/\text{m}^3$	GC/MS	10%

## 4 Test Parameters, Sample Preparation and Deviations

### 4.1 VOC Emission Chamber Test Parameters

Parameter	Value	Parameter	Value
Chamber volume, V[L]	1000	Preconditioning period	-
Air Change rate, $n[h^{-1}]$	0.5	Test period	22/05/2018 - 19/06/2018
Relative humidity of supply air, RH [%]	$50 \pm 3$	Area specific ventilation rate, q [m/h or m <sup>3</sup> /m <sup>2</sup> /h]	0.37
Temperature of supply air, T [°C]	$23 \pm 1$	Loading factor [m <sup>2</sup> /m <sup>3</sup> ]	1.35

### 4.2 Preparation of the Test Specimen

The sample was transferred directly into the chamber. All attachments were placed next to the cabinet.

### 4.3 Picture of Sample



## 4.4 Deviations from Referenced Protocols and Regulations

No deviations from the referenced test methods were observed except the general deviations.

### 4.4.1 General Deviations

Method	Deviation details	Impact on results or correction
EN 717-1 <sup>§</sup>	Sampling flow on DNPH was 330 mL/min. The RH% in the supply air to the chamber was $50 \pm 3\%$ and not $45 \pm 3\%$ during the test. The temperature was $23 \pm 1^\circ\text{C}$ and not $23 \pm 0.5^\circ\text{C}$ . The air change rate was 0.5/h and not 1/h. The sample was tested without open edges unless otherwise stated under sample preparation.	Formaldehyde concentration can be expected to be slightly overestimated compared to EN 717-1 due to the higher RH% and lower air change rate in ISO 16000-9. The E1 limit value of $120 \mu\text{g}/\text{m}^3$ has been recalculated to $\text{SER}_A$ of $120 \mu\text{g}/\text{m}^2/\text{h}$ and compared with the detected $\text{SER}_A$ (in accordance with conclusion presented in CEN TC351 WG2 N174).

## 5 Results

### 5.1 VOC Emission Test Results after 3 Days

	CAS No.	Retention time [min]	ID-Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Specific SER [µg/(m²·h)]	R <sub>D</sub>	R <sub>B</sub>
<b>VOC with NIK</b>								
Acetic acid * <sup>a</sup>	64-19-7	1.99	1	210	22	77	0.17	0.17
1-Butanol	71-36-3	2.55	1	27	8.0	9.9	0.0089	0.0089
Pentanal	110-62-3	2.95	1	39	13	14	0.049	0.049
Hexanal	66-25-1	4.94	1	180	91	67	0.20	0.20
Butyl acetate	123-86-4	5.30	1	6.0	< 5	2.2	0.0012	0.0012
Cyclohexanone *	108-94-1	6.89	1	31	15	11	0.075	0.075
Butylglycol *	111-76-2	7.13	1	10	6.8	3.7	0.0092	0.0092
α-Pinene *	80-56-8	7.66	1	13	13	4.9	0.0053	0.0053
Dipropylene glycolmethylether *	34590-94-8	8.73	1	21	12	7.6	0.0066	0.0066
3-Caren *	13466-78-9	8.91	1	5.3	5.5	2.0	0.0036	0.0036
Saturated aliphatic hydrocarbons higher than C9 *		8.0-10.35	2	37	37	14	0.0061	0.0061
<b>VOC without NIK</b>								
None determined								
<b>Sum of VOC without NIK</b>				< 5	< 5	< 2		
<b>VVOC compounds</b>								
None determined								
<b>TVVOC</b>				< 5	< 5	< 2		
<b>SVOC compounds</b>								
None determined								
<b>TSVOC</b>				< 5	< 5	< 2		
<b>Carcinogens</b>								
Dimethylformamide *	68-12-2	4.55	1	7.2	< 5	2.7	0.48	0.48
<b>Total carcinogens</b>				< 1	< 1	< 1		
<b>Aldehydes</b>								
Formaldehyde	50-00-0		1	48		18	0.48	0.48
Acetaldehyde	75-07-0		1	56		21	0.047	0.047
Propionaldehyde	123-38-6		1	93		34		
Butyraldehyde	123-72-8		1	7.5		2.8	0.012	0.012

The results are only valid for the tested sample(s).

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	CAS No.	Retention time [min]	ID- Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Specific SER [µg/(m²·h)]	R <sub>D</sub>	R <sub>B</sub>
2-butenal	123-73-9		1	< 5		< 2		
Glutaraldehyde	111-30-8		1	< 5		< 2		
<b>R-values</b>							1.5	1.6
<b>TVOC</b>				580	220	220		

## 5.2 VOC Emission Test Results after 28 Days

	CAS No.	Retention time [min]	ID-Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Specific SER [µg/(m²·h)]	R <sub>D</sub>	R <sub>B</sub>
<b>VOC with NIK</b>								
Acetic acid * <sup>a</sup>	64-19-7	1.88	1	150	44	57	0.12	0.13
1-Butanol	71-36-3	2.38	1	18	5.3	6.5	0.0058	0.0058
Pentanal	110-62-3	2.72	1	29	10	11	0.037	0.037
Hexanal	66-25-1	4.57	1	120	62	46	0.14	0.14
Cyclohexanone *	108-94-1	6.55	1	25	12	9.2	0.061	0.061
Butylglycol *	111-76-2	6.80	1	10	5.5	3.7	0.0091	0.0091
α-Pinene *	80-56-8	7.34	1	8.3	8.2	3.1	0.0033	0.0033
3-Caren *	13466-78-9	8.61	1	5.1	5.3	1.9	0.0034	0.0034
<b>VOC without NIK</b>								
Not identified *		8.10	4	10	10	3.7		
Not identified *		9.13	4	6.5	6.5	2.4		
Not identified *		11.75	4	6.3	6.3	2.3		
Not identified *		12.75	4	5.3	5.3	1.9		
<b>Sum of VOC without NIK</b>				28	28	10		
<b>VVOC compounds</b>								
None determined								
<b>TVVOC</b>								
				< 5	< 5	< 2		
<b>SVOC compounds</b>								
None determined								
<b>TSVOC</b>								
				< 5	< 5	< 2		
<b>Carcinogens</b>								
<b>Total carcinogens</b>								
				< 1	< 1	< 1		
<b>CMR substances</b>								
Benzene	71-43-2		1	< 1		< 1		
Trichloroethylene	79-01-6		1	< 1		< 1		
Dibutylphthalate (DBP)*	84-74-2		1	< 1		< 1		
Diethylhexylphthalate (DEHP)*	117-81-7		1	< 1		< 1		
<b>Aldehydes</b>								
Formaldehyde	50-00-0		1	32		12	0.32	0.32
Acetaldehyde	75-07-0		1	26		9.6	0.022	0.022

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	CAS No.	Retention time [min]	ID- Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Specific SER [µg/(m²·h)]	R <sub>D</sub>	R <sub>B</sub>
Propionaldehyde	123-38-6		1	38		14		
Butyraldehyde	123-72-8		1	6.1		2.3	0.0093	0.0093
2-butenal	123-73-9		1	< 5		< 2		
Glutaraldehyde	111-30-8		1	< 5		< 2		
<b>R-values</b>							0.73	0.73
<b>TVOC</b>				400	180	150		

## 6 Summary and Evaluation of the Results

### 6.1 Comparison with Limit Values of EN 717-1<sup>s</sup>

Parameter	Concentration mg/m <sup>3</sup>	E2 mg/m <sup>3</sup>	E1 mg/m <sup>3</sup>
Formaldehyde 28 days	0.032	> 0.10	≤ 0.10

The formaldehyde result is based on chamber testing and DNPH sampling according to ISO 16000. The result is therefore not directly according to the EN 717-1, and there are a few small deviations from EN 717-1 (see section on general deviations). The testing is in accordance with conclusions presented in CEN TC351 WG2 N174 where the difference and compatibility between EN 717-1 and ISO 16000 are empirically and theoretically analysed. For results close to the limit value it is recommended to perform an EN 717-1 test for verification.

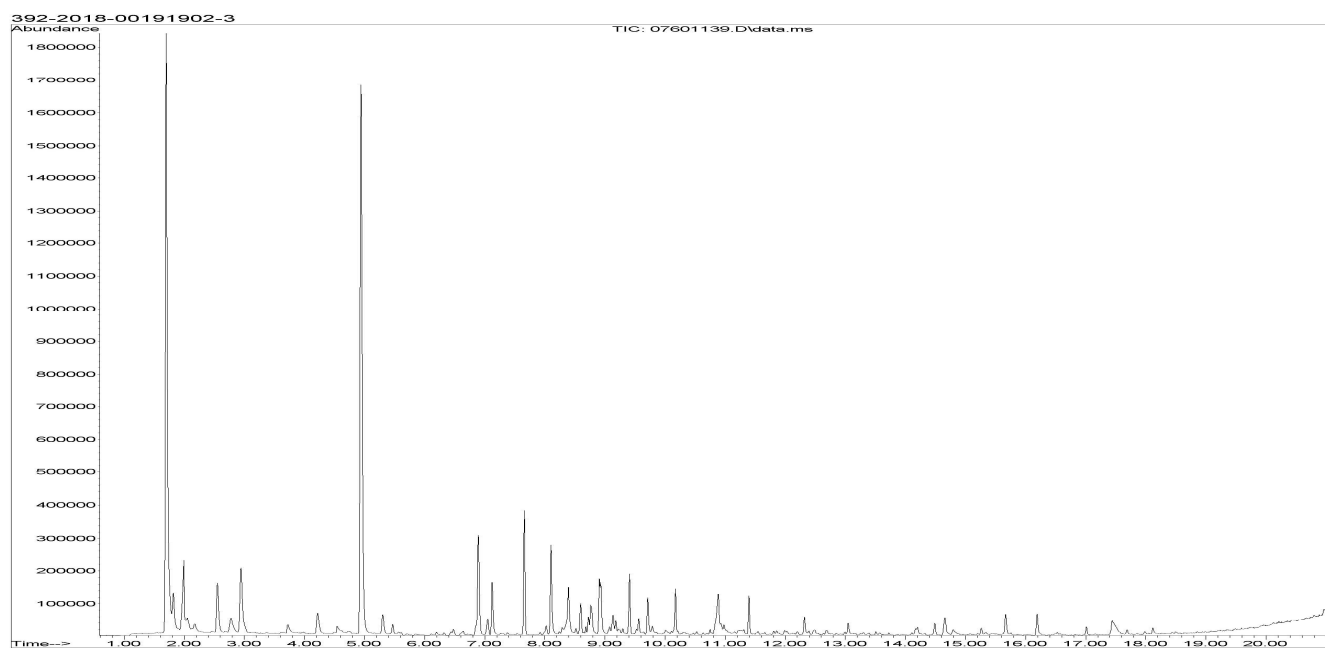
### 6.2 Comparison with Limit Values of Indoor Air Comfort<sup>®</sup>

	Test after 3 days		Test after 28 days	
	Concentration µg/m <sup>3</sup>	Limit Value µg/m <sup>3</sup>	Concentration µg/m <sup>3</sup>	Limit Value µg/m <sup>3</sup>
TVOC (EN 16516)	220	≤ 10000	180	≤ 1000
TSVOC	< 5	-	< 5	≤ 100
R <sub>D</sub> -value (NIK) (dimensionless)	1.5	-	0.73	≤ 1
R <sub>B</sub> -value (LCI) (dimensionless)	1.6	-	0.73	≤ 1
TVOC without NIK or LCI	< 5	-	28	≤ 100
Total carcinogens	< 1	≤ 10	-	-
Any individual carcinogens	-	-	< 1	≤ 1
CMR substances	-	-	< 1	≤ 1
Formaldehyde	48	-	32	≤ 60
Acetaldehyde	56	-	26	≤ 200

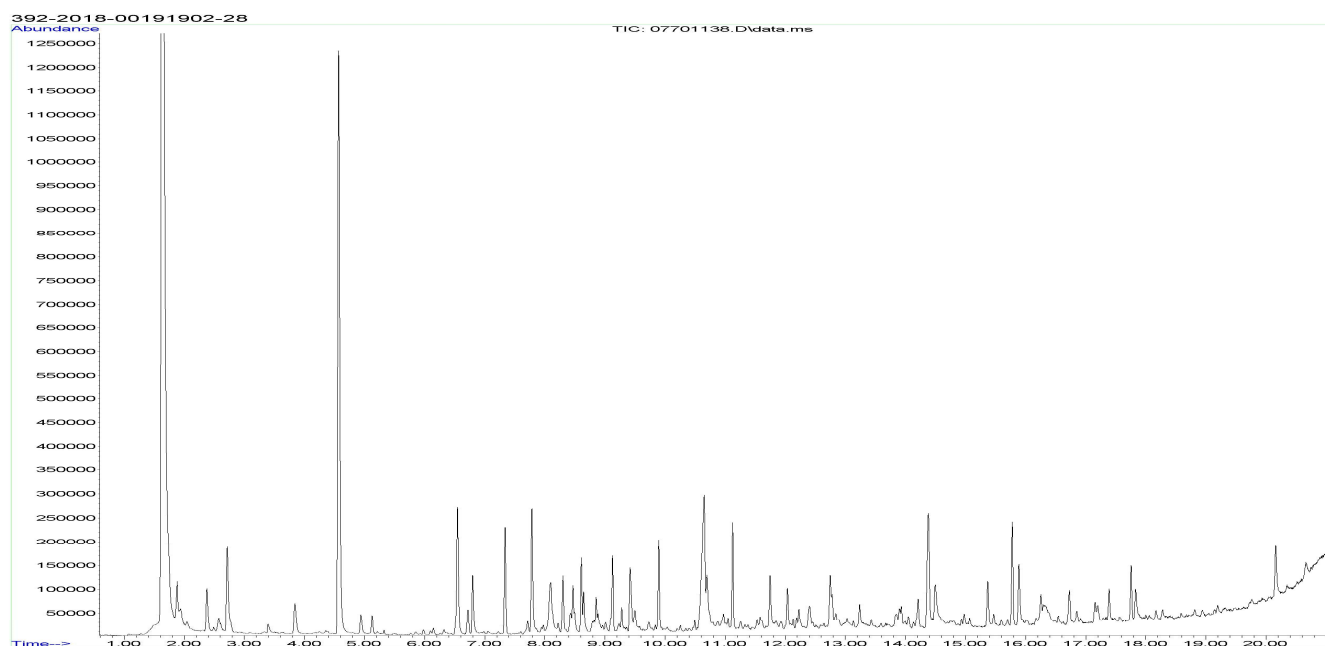
Compliance with the limits alone does not entitle to use the Indoor Air Comfort label. This requires an application, site inspection, and approval. See [www.eurofins.com/iac-procedures](http://www.eurofins.com/iac-procedures).

## 7 Appendices

### 7.1 Chromatogram of VOC Emissions after 3 Days



### 7.2 Chromatogram of VOC Emissions after 28 Days



Please consider the different scales.

The results are only valid for the tested sample(s).

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### 7.3 Sampling Report

<b>Name of applicant:</b> (name, company, phone):	Daniel Landberg, Kinnarps AB, +46 0706 386452	<b>Producer</b> (if different from company's name at place of sampling):	
<b>Production plant, where sampling takes place</b>	Kinnarps AB, Industrigatan 1, SE-521 88 Kinnarp	<b>Sampler *</b> (Please mark):	
		(name, company, phone):	Daniel Landberg, Kinnarps AB, +46 0706 386452
<b>Name of the product:</b>	S1P400 O PLBAW	<b>Type of product</b>	Storage, cabinet
<b>Model / Program / Series:</b>	Space	<b>Batch N°:</b>	825 1148 0010
<b>Article N°:</b>	S1P400 O PLBAW	<b>Date of batch production:</b>	2018-05-14
<b>Sample was taken from</b>	<input type="checkbox"/> ongoing production <input type="checkbox"/> stocks <input type="checkbox"/> retained sample	<b>Date of sampling:</b>	2018-05-14
		<b>Time of sampling:</b>	11.00
<b>Where had the product been stored prior to sampling?</b>	<input type="checkbox"/> production <input type="checkbox"/> store <input type="checkbox"/> miscellaneous	<b>How had the product been stored prior to sampling?</b>	<input type="checkbox"/> open <input type="checkbox"/> in the stack <input type="checkbox"/> wrapped up
<b>Place of storage:</b>	The sample was taken directly from production line and rapped in plastic bag	<b>Packing material:</b>	
<b>Specifics</b> (possible negative influences by air contamination where sample was taken, by petrol emissions, by solvent emissions from production; any other uncertainties, questions, etc).	no		
<b>Cut edges</b> (identification of cut edges when present and identification of new surfaces and surface to be exposed in the emission test):			
<b>Confirmation</b> Herewith the signer confirms the correctness of the data given above. The sample was selected, drawn and packed personally in accordance with the instructions for the taking of samples.			
<b>Date:</b>	<b>Signature:</b> (Stamp)		

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## 7.4 How to Understand the Results

### 7.4.1 Acronyms Used in the Report

- < Means less than
  - > Means bigger than
  - \* Not a part of our accreditation
  - ⌘ Please see section regarding uncertainty in the Appendices.
  - § Deviation from method. Please see deviation section
  - a The method is not optimal for very volatile compounds. For these substances smaller results and a higher measurement uncertainty cannot be ruled out.
  - b The component originates from the wooden panels and is thus removed.
  - c The results have been corrected by the emission from wooden panels.
  - d Very polar organic compounds are not suitable for reliable quantification using tenax TA adsorbent and HP-5 GC column. A high degree of uncertainty must be expected.
  - e The component may be overestimated due to contribution from the system
- SER Specific Emission Rate.

### 7.4.2 Explanation of ID Category

#### Categories of Identity:

- 1: Identified by comparison with a mass spectrum obtained from library and supported by other information and quantified through specific calibration.
- 2: Identified by comparison with a mass spectrum obtained from library and supported by other information. Quantified as toluene equivalent.
- 3: Identified with a lower match by comparison with a mass spectrum obtained from a library. Quantified as toluene equivalent.
- 4: Not identified, quantified as toluene equivalent.

## 7.5 Applied LCI and NIK Values

### 7.5.1 LCI/NIK Values for Compounds found after 3 Day Measurements

Compound	CAS No.	AgBB 2015 NIK [µg/m³]	Belgian NIK [µg/m³]
Acetic acid * <sup>a</sup>	64-19-7	1250	1200
1-Butanol	71-36-3	3000	3000
Pentanal	110-62-3	800	800
Dimethylformamide *	68-12-2	15	15
Hexanal	66-25-1	900	900
Butyl acetate	123-86-4	4800	4800
Cyclohexanone *	108-94-1	410	410
Butylglycol *	111-76-2	1100	1100
α-Pinene *	80-56-8	2500	2500
Dipropylene glycolmethylether *	34590-94-8	3100	3100
3-Caren *	13466-78-9	1500	1500
Saturated aliphatic hydrocarbons higher than C9 *		6000	6000
Formaldehyde	50-00-0	100	100
Acetaldehyde	75-07-0	1200	1200

### 7.5.2 LCI/NIK Values for Compounds found after 28 Day Measurements

Compound	CAS No.	AgBB 2015 NIK [µg/m³]	Belgian NIK [µg/m³]
Acetic acid * <sup>a</sup>	64-19-7	1250	1200
1-Butanol	71-36-3	3000	3000
Pentanal	110-62-3	800	800
Hexanal	66-25-1	900	900
Cyclohexanone *	108-94-1	410	410
Butylglycol *	111-76-2	1100	1100
α-Pinene *	80-56-8	2500	2500
3-Caren *	13466-78-9	1500	1500
Formaldehyde	50-00-0	100	100
Acetaldehyde	75-07-0	1200	1200

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## 7.6 Description of VOC Emission Test

### 7.6.1 Test Chamber

The test chamber is made of stainless steel. A multi-step air clean-up is performed before loading the chamber, and a blank check of the empty chamber is performed.

The chamber operation parameters are as described in the test method section. (EN 16516, ISO 16000-9, internal method no.: 71M549811).

### 7.6.2 Expression of the Test Results

All test results are calculated as specific emission rate, and as extrapolated air concentration in the European Reference Room (EN 16516, AgBB, EMICODE, M1 and Indoor Air Comfort).

### 7.6.3 Testing of Carcinogenic VOCs

The emission of carcinogens (EU Categories C1A and C1B, as per European law) is tested by drawing sample air from the test chamber outlet through Tenax TA tubes after the specified duration of storage in the ventilated test chamber. Analysis is performed by ATD-GC/MS (automated thermal desorption coupled with gas chromatography and mass spectroscopy using 30 m HP-5 (slightly polar) column with 0.25 mm ID and 0.25  $\mu$ m film, Agilent) (EN 16516, ISO 16000-6, internal methods no.: 71M549812 / 71M542808B).

All identified carcinogenic VOCs are listed; if a carcinogenic VOC is not listed then it has not been detected. Quantification is performed using the TIC signal and authentic response factors, or the relative response factors relative to toluene for the individual compounds.

This test only covers substances that can be adsorbed on Tenax TA and can be thermally desorbed. If other emissions occur, then these substances cannot be detected (or with limited reliability only).

### 7.6.4 Testing of VOC, SVOC and VVOC

The emissions of volatile organic compounds are tested by drawing sample air from the test chamber outlet through Tenax TA tubes after the specified duration of storage in the ventilated test chamber. Analysis is performed by ATD-GC/MS using HP-5 column (30 m, 0.25mm ID, 0.25 $\mu$ m film) (EN 16516, ISO 16000-6, internal methods no.: 71M549812 / 71M542808B).

All single substances that are listed with a LCI/NIK value in the latest publications (hereafter referred to as target compounds) are identified if present. All other appearing VOCs are identified as far as possible. Quantification of target compounds is done using the TIC signal and authentic response factors, or the relative response factors relative to toluene. For certain compound groups, which differ significantly in chemistry from toluene, quantification is performed relative to a representative member of the group for more accurate and precise results. This can include quantification of for example glycols and acids. In addition to that, all results are also expressed in toluene equivalents. All non-target compounds, as well as all non-identified substances, are quantified in toluene equivalents.

The results of the individual substances are calculated in three groups depending on their retention time when analyzing using a non-polar column (HP-5):

- Volatile Organic Compounds (VOC) are defined as: All substances eluting between and including n-hexane (n-C6) and n-hexadecane (n-C16)
- Semi-Volatile Organic Compounds (SVOC) are defined as: All substances eluting after n-hexadecane (n-C16) and before and including n-docosane (n-C22)
- Very Volatile Organic Compounds (VVOC) are defined as: All substances eluting before n-hexane (n-C6).

Total Volatile Organic Compounds (TVOC) is calculated by summation of all individual VOCs with a concentration  $\geq 5 \mu\text{g}/\text{m}^3$ . The TVOC can be expressed either in toluene equivalents as defined in EN 16516 and similar to ISO 16000-6, or as the sum of concentrations using specific or relative response factors. In the case of summation of concentrations using authentic or relative response factors, the toluene equivalent is applied to all non-target and non-identified VOCs before summing up. Compounds regarded as VOC in line with the above definition but elute before n-C6 or after n-C16 on the HP-5 column are treated as VOC, and are thus added to the TVOC.

Total Semi-Volatile Organic Compounds (TSVOC) is calculated by the summation of all individual SVOCs expressed in toluene equivalents with a concentration  $\geq 5 \mu\text{g}/\text{m}^3$ , as defined in EN 16516. VOCs that are regarded as VOC in line with the above definition, but elute after n-C16 in this test, are not added to the TSVOC.

Total Very Volatile Organic Compounds (TVVOC) is calculated by the summation of all individual VVOCs with a concentration  $\geq 5 \mu\text{g}/\text{m}^3$  and expressed in toluene equivalents. VOCs that are regarded as VOC in line with the above definition, but elute before n-C6 in this test, are not added to the TVVOC.

This test only covers substances which can be adsorbed on Tenax TA and can be thermally desorbed. If emissions of substances outside these specifications occur then these substances cannot be detected (or with limited reliability only).

#### 7.6.5 Calculation of R Values with LCI Lists

The concentrations of detected compounds  $\geq 5 \mu\text{g}/\text{m}^3$  are divided by their respective LCI/NIK value (if defined in the given publication). The sum of the quotients gives the R value, which can be mathematically expressed:

$$R = \sum_i^n \left( \frac{c_i}{\text{NIK}_i} + \dots + \frac{c_n}{\text{NIK}_n} \right)$$

This R value is calculated, depending on the purpose of this test, for the European LCI list, for the German LCI/NIK list ( $R_D$ ), and/or for the Belgian LCI list ( $R_B$ ).

All VOCs without published LCI/NIK value and concentration  $\geq 5 \mu\text{g}/\text{m}^3$  are summed up as sum of VOCs without LCI/NIK if required by the standard or protocol.

#### 7.6.6 Testing of Aldehydes

The presence of aldehydes is tested by drawing air samples from the test chamber outlet through DNPH-coated silicagel tubes after the specified duration of storage in the ventilated test chamber. Analysis is performed by solvent desorption and subsequently by HPLC and UV-/diode array detection.

The absence of formaldehyde and other aldehydes is stated if UV detector response at the specific wavelength is lacking at the specific retention time in the chromatogram. Otherwise it is checked whether the reporting limit is exceeded. In this case the identity is finally checked by comparing full scan sample UV spectra with full scan standard UV spectra.

#### 7.6.7 Testing of Phthalates

The presence of phthalates is tested by drawing air samples from the test chamber outlet through tube with XAD-II adsorbent after the specified duration of storage in the ventilated test chamber. Analysis is performed by solvent desorption and subsequently by GC/MS. Analysis of phthalates is not currently covered by the accreditation (Internal methods no.: 71M549812 / 71M546060).



## 7.7 Quality Assurance

Before loading the test chamber, a blank check of the empty chamber is performed and compliance with background concentrations in accordance with EN 16516 / ISO 16000-9 is determined.

Air sampling at the chamber outlet and subsequent analysis is performed in duplicate. Relative humidity, temperature and air change rate in the chambers is logged every 5 minutes and checked daily. A double determination is performed on random samples at a regular interval and results are registered in a control chart to ensure the uncertainty and reproducibility of the method.

The stability of the analytical system is checked by a general function test of device and column, and by use of control charts for monitoring the response of individual substances prior to each analytical sequence.

## 7.8 Accreditation

The testing methods described above are accredited on line with EN ISO/IEC 17025 by DANAK (no. 522). This accreditation is valid worldwide due to mutual approvals of the national accreditation bodies (ILAC/IAF, see also [www.eurofins.com/galten.aspx#accreditation](http://www.eurofins.com/galten.aspx#accreditation)).

Not all parameters are covered by this accreditation. The accreditation does not cover parameters marked with an asterisk (\*), however analysis of these parameters is conducted at the same level of quality as for the accredited parameters.

## 7.9 Uncertainty of the Test Method

The relative standard deviation of the overall analysis is 22%. The expanded uncertainty  $U_m$  equals 2 x RSD. For further information please visit [www.eurofins.dk/uncertainty](http://www.eurofins.dk/uncertainty).