armacell®

BREEAM COMPLIANCE PRODUCT CARD

Technical insulation

TECHNICAL INSULATION | COOLING | AIR CONDITIONING

Armaflex Ultima

Armaflex Ultima is a flexible elastomeric foam on the basis of patented synthetic rubber composition for use in HVAC, refrigeration and process equipment applications[1].

BREEAM International New Construction 2013

BREEAM is a multi-criteria scheme to assess and certify buildings. Established in UK, it emphasises sustainable development by promoting green, healthy and eco-friendly buildings. Features of the buildings which may be assesed are: materials, quality of indoor enviroments and energy efficiency etc. Nowadays it has become a standard in real estates markets.

BREEAM compliance product card for **Armaflex Ultima** was prepared to assist designers, architects, engineers, consultants and developers to provide clear information and to facilitate choosing proper product. Appropriate BREEAM categories related to Armaflex Ultima features were chosen and checked. Armaflex Ultima compliance and contribution to BREEAM categories are presented below.

✓ Product compliant ℹ Product contributes to a better rating

BREEAM Category	Issue	BREEAM Requirements	Credits	Product compliance	
Life cycle cost and service life planning	Man 05	A life cycle cost and service life planning analysis of the building components should be carried out in order to obtain their full information through all the life cycle.	3••	Armaflex Ultima life cycle information may be a part of the building analysis. The following data may be useful: - life cycle durability: as the service life of the equipment or the whole building (> 50 years), - restrictions: insulation thicknesses are available for all common pipe diameters up to an outer diameter of 89 mm for tubes; temperature range: -50°C to +110°C, - recycling: non-recyclable, - costs: during installation and utilization (no costs while in use), - comparison to natural rubber: better temperature resistance - less heat/cold losses and extremely constant quality. More information may be found in Environmental Product Declaration[2].	ℹ
Life cycle impacts	Mat 01	An environmental impact of construction materials over the building life cycle should be specified by using an appropriate life cycle assessment (LCA) tool.	7••	Data useful for life cycle assessment (LCA) may be found in Environmental Product Declaration (EPD)[2]. Life cycle assessment in EPD has been carried out in GaBi Software (LCA tool), which is based on ISO 14025 standard and addresses the whole life cycle of product, including disposal.	ℹ
Insulation	Mat 04	Construction materials should be responsibly sourced. A responsibly sourced confirmation of „supply chain process" and „key process" should be provided.	1•	Armaflex Ultima is responsibly sourced which may be confirmed with ISO14001[3] certificates for: - supply chain process (polymer) - key process (insulation production).	✓
Thermal comfort	Hea 03	A thermal comfort analysis shoud be carried out to assess if the indoor environment maintains comfortable conditions for building users in terms of appropriate thermal comfort level according to ISO 7730:2005.	2••	Armaflex Ultima is a part of building's systems. Adjusting proper design parameters will enable to improve energy efficiency and its supply to the system appliances. For energy efficiency the main parameter of Armaflex Ultima is thermal conductivity $\lambda_{0°C} \leq 0{,}040$ W/mK[1].	
Reduction of energy use and carbon emissions	Ene 01	An energy performance should be carried out to assess building energy consumption during operation in comparison with the notional building (parameters defined by national standards).	15••		ℹ
Energy efficient cold storage	Ene 05	Greenhouse gas emissions from cold storage systems should be reduced by improving their energy efficiency.	3••		

For detailed information please refer to the documents provided by manufacturer:
[1] Armaflex Ultima product card
[2] Environmental Product Declaration: EPD-ARM-20150109-IBB1-DE
[3] ISO 14001 certificates are avaliable for the factories in Muenster (Germany), Begur (Spain) as well as for main polymers production.

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• Armaflex Ultima has a direct impact on the following categories. While using Armaflex Ultima with another appropriate products - credits stated above may be awarded. Maximum number of credits influenced by the product for each category was stated above.
•• Armaflex Ultima has an indirect impact on the following categories. Using Armaflex Ultima with another appropriate products may contribute to achieve credits. Maximum number of credits influenced by the product for each category was stated above.

Armacell complince product card was prepared in cooperation with **Sweco Consulting**. Compliance products card is based on the manufacturer information. Compliance product card is not an official evidence for BREEAM certification process. Sweco Consulting does not take the responsibility for any changes in compliance product card or product parameters. Version of the compliance product card: 1.0

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BREEAM International New Construction 2016

BREEAM is a multi-criteria scheme to assess and certify buildings. Established in UK, it emphasises sustainable development by promoting green, healthy and eco-friendly buildings. Features of the buildings which may be assesed are: materials, quality of indoor enviroments and energy efficiency etc. Nowadays it has become a standard in real estates markets.

BREEAM compliance product card for **Armaflex Ultima** was prepared to assist designers, architects, engineers, consultants and developers to provide clear information and to facilitate choosing proper product. Appropriate BREEAM categories related to Armaflex Ultima features were chosen and checked. Armaflex Ultima compliance and contribution to BREEAM categories are presented below.

✓ Product compliant ℹ Product contributes to a better rating

BREEAM Category	Issue	BREEAM Requirements	Credits	Product compliance	
Life cycle cost and service life planning	Man 02	A life cycle cost and service life planning analysis of the building components and elements should be carried out in order to obtain their full information through all the life cycle.	3••	Armaflex Ultima life cycle information may be a part of the building analysis. The following data may be useful: - life cycle durability: as the service life of the equipment or the whole building (> 50 years), - restrictions: insulation thicknesses are available for all common pipe diameters up to an outer diameter of 89 mm for tubes; temperature range: -50°C to +110°C, - recycling: non-recyclable, - costs: during installation and utilization (no costs while in use), - comparison to natural rubber: better temperature resistance - less heat/cold losses and extremely constant quality. More information may be found in Environmental Product Declaration[2].	ℹ
Life cycle impacts	Mat 01	An environmental impact of construction materials over the building life cycle should be specified by using an appropriate life cycle assessment (LCA) tool.	5••	Data useful for life cycle assessment (LCA) may be found in EPD[2]. Life cycle assessment in EPD has been carried out in GaBi Software (LCA tool), which is based on ISO 14025 standard and addresses the whole life cycle of product, including disposal.	ℹ
		At least five products out of ten material categories, including insulation products, should have Environmental Products Declarations (EPD). In one material category maximum two products' EPDs may be counted. The EPD must be compliant with ISO 14025, ISO 21930 or EN 15804.	2•	Using Armaflex Ultima with other products having EPD will help to score a credit. Armaflex Ultima EPD[2] is compliant with ISO 14025 and ISO 15804.	✓
Responsible sourcing of construction	Mat 03	Construction materials should be responsibly sourced. A responsibly sourced confirmation of „supply chain process" and „key process" should be provided.	4•	Armaflex Ultima is responsibly sourced which may be confirmed with ISO14001[4] certificates for: - supply chain process (polymer) - key process (insulation production).	✓
Material efficiency	Mat 06	In order to minimise materials' environmental impact more efficient materials should be used during building design, procurement, construction, maintenance and end of life.	1••	Armaflex Ultima as a part of building energy system has the following efficiency features: - a service life is more than 50 years, - it may be damaged only by extraordinary impacts or during installation, - varied packaging: appropriate size and package type (tubes, tapes and sheets). Packaging waste is reduced.	ℹ
Thermal comfort	Hea 04	A thermal comfort analysis shoud be carried out to assess if the indoor environment maintains comfortable conditions for building users in terms of appropriate thermal comfort level according to ISO 7730:2005.	3••	Armaflex Ultima is a part of building's systems. Adjusting proper design parameters will enable to improve energy efficiency and its supply to the system appliances. For energy efficiency the main parameter of Armaflex Ultima is thermal conductivity $\lambda_{0°C} \leq 0{,}040$ W/mK[1].	
Reduction of energy use and carbon emissions	Ene 01	An energy performance should be carried out to assess building energy consumption during operation in comparison with the following requirements: notional building (parameters defined by national standards) and BREEAM best practice building (BREEAM defined parameters).	15••		ℹ
Energy efficient cold storage	Ene 05	Greenhouse gas emissions from cold storage systems should be reduced by improving their energy efficiency.	3••		

For detailed information please refer to the documents provided by manufacturer:
[1] Armaflex Ultima product card
[2] Environmental Product Declaration: EPD-ARM-20150109-IBB1-DE
[3] Eurofins Product Testing A/S attestation and test report data
[4] ISO 14001 certificates are avaliable for the factories in Muenster (Germany), Begur (Spain) as well as for main polymers production.

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LEED COMPLIANCE PRODUCT CARD

Technical insulation

TECHNICAL INSULATION | COOLING | AIR CONDITIONING

Armaflex Ultima

Armaflex Ultima is a flexible elastomeric foam on the basis of patented synthetic rubber composition for use in HVAC, refrigeration and process equipment applications[1].

LEED 2009

for Green Building Design and Construction

LEED is a multi-criteria scheme to assess and certify buildings. Established in USA, it emphasises sustainable development by promoting green, healthy and eco-friendly buildings. Features of the buildings which may be assesed are: materials, quality of indoor enviroments and energy efficiency etc. Nowadays it has become a standard in real estates markets.

LEED compliance product card for **Armaflex Ultima** was prepared to assist designers, architects, engineers, consultants and developers to provide clear information and to facilitate choosing proper product. Appropriate LEED categories related to Armaflex Ultima features were chosen and checked. Armaflex Ultima compliance and contribution to LEED categories are presented below.

✓ Product compliant ⓘ Product contributes to a better rating

LEED Issue		Credit	LEED Requirements	Points	Product compliance
EA	Prerequisite 2	Minimum Energy Performance	Building's energy performance calculated using computer simulation model should demonstrate a 10% improvement for new buildings, or a 5% for major renovations in comparison to the baseline as a compulsory achievement by using energy efficient measures.	-	Armaflex Ultima is a part of building's systems. Adjusting proper design parameters will enable to improve energy efficiency and its supply to the system appliances. For energy efficiency the main parameter of the Armaflex Ultima is thermal conductivity $\lambda_{0°C} \leq 0{,}040$ W/mK[1]. ⓘ
EA	Credit 1	Optimize Energy Performance	Building's energy performance calculated using computer simulation model should demonstrate an improvement in comparison to the baseline. Number of points awarded depends on percentage improvment and building type.	21••	
IEQ	Credit 7.1	Thermal Comfort	An appropriate level of thermal comfort within the building should be provided by designing HVAC systems in accordance with ASHRAE 55-2004 Thermal Environmental Conditions for Human Occupancy.	1••	Armaflex Ultima has got an indirect impact on achieving acceptable range of operative temperature and humidity by providing protection for pipes or air ducts. Therefore it prevents condensation of the humidified air. Water vapour diffusion resistance of Armaflex Ultima is : $\mu \geq 7\,000$[1]. ⓘ
IEQ	Credit 7.2	Thermal Comfort – Verification	A measurements of relevant environmental variables in potential problem areas indicated by building's occupants should be conducted. Measurements should be carried out in accordance with ASHRAE standard 55-2004.	1••	

For detailed information please refer to the documents provided by manufacturer:
[1] Armaflex Ultima product card

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•• Armaflex Ultima has an indirect impact on the following categories. Using Armaflex Ultima with another appropriate products may contribute to achieve credits. Maximum number of credits influenced by the product for each category was stated above.

Armacell complince product card was prepared in cooperation with **Sweco Consulting**. Compliance products card is based on the manufacturer information. Compliance product card is not an official evidence for LEED certification process. Sweco Consulting does not take the responsibility for any changes in compliance product card or product parameters. Version of the compliance product card: 1.0

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LEED COMPLIANCE PRODUCT CARD

Technical insulation

TECHNICAL INSULATION | COOLING | AIR CONDITIONING

Armaflex Ultima

Armaflex Ultima is a flexible elastomeric foam on the basis of patented synthetic rubber composition for use in HVAC, refrigeration and process equipment applications[1].

LEED v4

for Building Design and Construction

LEED is a multi-criteria scheme to assess and certify buildings. Established in USA, it emphasises sustainable development by promoting green, healthy and eco-friendly buildings. Features of the buildings which may be assesed are: materials, quality of indoor enviroments and energy efficiency etc. Nowadays it has become a standard in real estates markets.

LEED compliance product card for **Armaflex Ultima** was prepared to assist designers, architects, engineers, consultants and developers to provide clear information and to facilitate choosing proper product. Appropriate LEED categories related to Armaflex Ultima features were chosen and checked. Armaflex Ultima compliance and contribution to LEED categories are presented below.

✓ Product compliant ⓘ Product contributes to a better rating

LEED Issue		Credit	LEED Requirements	Points	Product compliance	
EA	Prerequisite Minimum Energy Performance	Option 1. Whole-building energy simulation	An energy calculation should be carried out based on a simulation model in accordance to the ANSI/ASHRAE/IESNA Standard 90.1-2010, Appendix G with errata. An improvement of 5% (new construction projects), 3% (major renovations projects), 2% (core and shell projects) over a baseline should be demonstrated.	-	Armaflex Ultima is a part of building's systems. Adjusting proper design parameters will enable to improve energy efficiency and its supply to the system appliances. For energy efficiency the main parameter of the Armaflex Ultima is thermal conductivity $\lambda_{0°C} \leq 0{,}040$ W/mK[1].	
EA	Optimize Energy Performance	Option 1. Whole-building energy simulation	Building's energy performance calculated using computer simulation model should demonstrate an improvement in comparison to the baseline. Number of points awarded depends on percentage improvment.	18••		ⓘ
EQ	Thermal Comfort	Thermal Comfort Design Option 2. ISO and CEN Standards	A thermal comfort analysis should be carried out in accordance to the standards: ISO 7730:2005 and EN 15251:2007.	1••		
MR	Building Product Disclosure and Optimization – Environmental Product Declarations	Option 1. Environmental Product Declarations (EPD)	At least 20 materials sourced from 5 different manufacturers should have product specific Type III EPD. EPD should conform standards: ISO 14025, ISO 14040, ISO 14044 and EN 15804, at least cradle to gate scope and include an external verification.	1•	Armaflex Ultima has got an EPD[2] with a third party certification (Type III) in accordance to ISO 14025 and EN 15804 and includes an external verification. A cradle to grave scope has been provided.	✓
EQ	Low-Emitting Materials	Option 1. Product category calculations	Up to 7 product categories of finishing materials should be compliant with relevant volatile organic compounds (VOC) emission levels and testing standards: - CDPH Standard Method (2010) or - German AgBB Testing and Evaluation Scheme (2010) or - ISO 16000-3/6/9/11:2010 in conjunction with AgBB or French legislation on VOC emission class labeling or the DIBt testing method (2010).	3•	Armaflex Ultima has been tested[3] in accordance to: German AgBB Testing and Evaluation Scheme (2010). Product complies with limit values of the AgBB.	✓
EQ	Thermal Comfort	Thermal Comfort Design Option 1. ASHRAE Standard 55-2010	An appropriate level of thermal comfort within the building should be provided by designing HVAC systems in accordance with ASHRAE 55-2010 Thermal Environmental Conditions for Human Occupancy with errata or a local equivalent.	1••	Armaflex Ultima has got an indirect impact on achieving acceptable range of operative temperature and humidity by providing protection for pipes or air ducts. Therefore it prevents condensation of the humidified air. Water vapour diffusion resistance of Armaflex Ultima is : $\mu \geq 7\,000$[1].	ⓘ

For detailed information please refer to the documents provided by manufacturer:
[1] Armaflex Ultima product card
[2] Environmental Product Declaration: EPD-ARM-20150109-IBB1-DE
[3] Fraunhofer Institute for Wood Research, Test report No. MAIC-2012-2101

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•• Armaflex Ultima has an indirect impact on the following categories. Using Armaflex Ultima with another appropriate products may contribute to achieve credits. Maximum number of credits influenced by the product for each category was stated above.

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WELL COMPLIANCE PRODUCT CARD

Technical insulation

TECHNICAL INSULATION

COOLING

HVAC

Armaflex Ultima

AF/Armaflex is a flevible, closed-cell elastomeric foam on the basis of patented synthetic rubber composition. Product has improved fire retardant properties and low smoke generation. The product is used in HVAC, refrigeration and process equipment as insulation and protection of pipes, air ducts, vessels.

WELL Building Standard version 2 (WELL v2)

WELL is a performance-based system for measuring, certifying, and monitoring features of the built environment that impact human health and wellbeing, through air, water, nourishment, light, fitness, comfort, and mind. WELL Certification requires a passing score in each of these seven categories. WELL Certified spaces can help create a built environment that improves the nutrition, fitness, mood, sleep patterns, and performance of its occupants.
WELL is grounded in a body of medical research that explores the connection between the buildings and the health and wellness of its occupants.

WELL compliance product card for Armaflex Ultima was prepared to assist designers, architects, engineers, consultants and developers to provide clear information and to facilitate choosing proper product. Appropriate WELL features related to Armaflex Ultima product were chosen and checked. Armaflex Ultima compliance and contribution to WELL features are presented below.

Product compliant

Product contributes to a better rating

WELL feature	Feature type	WELL Requirements	Product Compliance	
X01: Material Restrictions Część 1: Restrict asbestos	Preconditions*	For newly installed or applied products, including all insulation (lagging) applied to pipes, fittings, boilers, tanks and ducts, do not contain over 1,000 ppm of asbestos by weight or area .	Armaflex Ultima product is completely asbestos-free. Product compliance was confirmed on the basis of manufacturer's statement	✔
X06: VOC Restrictions Part 2: Restrict VOC Emissions from Furniture, Architectural and Interior Products	Optimization**	At least 75% by cost or surface area of insulation was tested per methods and VOC emission thresholds established in one of the following: a. California Department of Public Health (CDPH) Standard Method v1.2. b. AgBB. c. European Union LCI VOC thresholds10 following EN 16516-1:2017 testing methods.	Sampling, testing and evaluation of the Armaflex Ultima product was performed in accordance with AgBB standard. On the basis of the research, the insulation meets an adequate level of VOC emission. .	ℹ
X07: Materials Transparency Part 1: Select product with Disclosed Ingredients	Optimization**	For at least 50% by count or 25 distinct, permanently installed products, including insulation, ingredients are disclosed by the manufacturer, a disclosure organization or a third party through one of the following: a. A Declare label, operated by the International Living Future Institute b. A Health Product Declaration (HPD) published in the HPD Public Repository, operated by the Health Product Declaration Collaborative c. A Cradle-to-Cradle Certified™ product, or a product with a Material Health Certificate from the Cradle to Cradle Products Innovation Institute d. A Product Lens Certification™, operated by UL e. A Product Health Declaration, operated by Global Green Tag f. A manufacturer's inventory containing CAS numbers of all individual compounds down to 1,000 ppm (0.1%).	Composition of the the Armaflex Ultima product, which includes CAS numbers of all individual compunds down to 1000 ppm was disclosed by the manufacturer and confirms material's transparency. Product compliance was confirmed on the basis of VOC emission's reaseach, where CAS numbers were specified.	ℹ
X07: Materials Transparency Part 2: Select product with Enhanced Ingredients Disclosure	Optimization**	For at least 15 distinct permanently installed products, including insulation, all ingredients are disclosed down to 100 ppm by the manufacturer, a disclosure organization or a third party through one of the following: a. A Declare label, operated by the International Living Future Institute b. A Health Product Declaration (HPD) published on the HPD repository c. Manufacturer's disclosure and/or through a third-party materials database platform.	The Armaflex Ultima product has Environmental Product Declaration (EPD) of Type III that complies with ISO 14025 and EN 15804. The product's EPD was externally verified and includes ,,cradle to gate,, scope. Product compliance was confirmed by manufacturer's disclosure .	ℹ

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WELL COMPLIANCE PRODUCT CARD

Product compliant

Product contributes to a better rating

WELL feature	Feature type	WELL Requirements	Product Compliance
X08: Materials Optimization Part 1: Materials selection	Optimization**	For at least 25 distinct permanently installed products , including insulation, ingredients are inventoried to 100 ppm and one of the following is met: a. Product is free of compounds listed in the Living Building Challenge's Red List v.4.0. b. Product meets the chemical thresholds in the Cradle to Cradle Basic Level Restricted Substances List, version 4. c. Product does not contain compounds listed in REACH Restriction, Authorization and SHVC lists. d. Product meets an optimization path listed under 'Advanced Inventory & Assessment' in Option 2 of LEED v4.1 credit 'Building Product Disclosure and Optimization - Material Ingredients'.5	The Armaflex Ultima product has Environmental Product Declaration (EPD) which indicates the product does not contain substances (SVHC) specified in annex XIV (List of Substances Subject to Authorisation) as laid down in Article 57 and article 59 of REACH. The Armaflex Ultima product compliance was also confirmed on the basis of manufacturer's REACH compliance declaration.

For detailed information please refer to the documents provided by manufacturer:

[1] VOC test report No. MAIC-2012-2102

[2] AF/Armaflex Ultima product card

[3] Environmental Product Declaration (EPD) for AF/Armaflex Ultima: EPD-ARM-20200218-IBB1-EN

* AF/Armaflex Ultima has a direct impact on the following categories. While using AF/Armaflex Ultima with another appropriate products– Preconditions or Optimizations in current concept will be available.

** AF/Armaflex Ultima has an indirect impact on the following categories. Using AF/Armaflex Ultima with another appropriate products may contribute to meet Preconditions or Optimizations in current concept.

Preconditions– these are fundamental features, for WELL v2 certification or compliance to be awarded, all applicable Preconditions must be met.

Optimizations– these features include optional technologies, strategies, protocols and designs that can be applied to a project to qualify for WELL v2 Certification at either Bronze, Silver, Gold or Platinum level.

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eurofins | Product Testing

ilac-MRA DANAK TEST Reg.nr. 522

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VOC EMISSION TEST REPORT
Indoor Air Comfort GOLD®

28 April 2022

1 Sample Information

Sample name	ArmaFlex Ultima – MMS21/016-6
Batch no.	MS00156167
Stated production date	24/02/2022
Product type	Technical insulation
Thickness, mm	19
Sample reception	03/03/2022

2 Brief Evaluation of the Results

Regulation or protocol	Conclusion	Version of regulation or protocol
French VOC Regulation §	A+	Decree of March 2011 (DEVL1101903D) and Arrêté of April 2011 (DEVL1104875A) modified in February 2012 (DEVL1133129A)
French CMR components §	Pass	Regulation of April and May 2009 (DEVP0908633A and DEVP0910046A)
Italian CAM Edilizia §	Pass	Decree 11 October 2017 (GU n.259 del 6-11-2017)
ABG/AgBB §	Pass	Ausschuss zur gesundheitlichen Bewertung von Bauprodukten (June 2021)
Belgian Regulation §	Pass	Royal decree of May 2014 (C-2014/24239)
Indoor Air Comfort® §	Pass	Indoor Air Comfort 7.0 of May 2020
Indoor Air Comfort GOLD® §	Pass	Indoor Air Comfort GOLD 7.0 of May 2020
Blue Angel (DE-UZ 132) §	Pass	Low-Emission Thermal Insulation Material and Suspended Ceilings for Use in Buildings, January 2020
BREEAM International §	Exemplary Level	BREEAM International New Construction v6.0 (2021)
LEED v4.1 BETA (outside U.S.) §	Pass	LEED v4.1 BETA for Building Design and Construction (February 2021)

Full details based on the testing and direct comparison with limit values are available in the following pages
Regarding pass/fail decision rule please see appendix

§ see section 4.4 on deviations

Laura Hartung Sørensen
Analytical Service Manager

Rasmus Verdier
Analytical Service Manager

The results are only valid for the tested sample(s).
This report may only be copied or reprinted in its entity.

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3 Applied Test Methods

3.1 General Test References

Regulation, protocol or standard	Version	Reporting limit VOC [µg/m³]	Calculation of TVOC	Combined uncertainty¤ [RSD(%)]
EN 16516	2017 + A1:2020	5	Toluene equivalents	22%
ISO 16000 -3 -6 -9 -11	2006-2021 depending on part	2	Toluene equivalents	22%
ASTM D5116-10	2010	-	-	-
Specifications Indoor Air Comfort Gold	7.0 of May 2020	5	Toluene equivalents	22%
French VOC Classes	Decree of 03/2011 (DEVL1101903D) and arrêté of 02/2012 (DEVL1133129A)	2	Toluene equivalents	22%
French CMR	Regulation of April and May 2009 (DEVP0908633A and DEVP0910046A)	1	Toluene equivalents	22%
Italian CAM Edilizia	Decree 11 October 2017. Section 2.3.5.5	2	Toluene equivalents	22%
AgBB (MVV TB/ABG)	June 2021 (2020/2019)	5	Compound Specific	22%
Belgian VOC	Royal decree of May 2014 (C - 2014 / 24239)	5	Toluene equivalents	22%
BREEAM International	BREEAM International New Construction v6.0 (2021)	5	Toluene equivalents	22%
LEED v4.1 BETA (outside U.S.)	February 2021	5	Compound Specific	22%
Blue Angel (DE-UZ 132)	January 2020	5	Compound Specific	22%

3.2 Specific Laboratory Sampling and Analyses

Procedure	External Method	Internal SOP	Quantification limit / sampling volume	Analytical principle	Uncertainty¤ [RSD(%)]
Sample preparation	ISO 16000-11:2006, EN 16516:2017+A1:2020, AgBB:2021, EMICODE:2020	71M549810	-	-	-
Emission chamber testing	ISO 16000-9:2006, EN 16516:2017+A1:2020	71M549811	-	Chamber and air control	-
Sampling of VOC	ISO 16000-6:2021, EN 16516:2017+A1:2020	71M549812	5 L	Tenax TA	-
Analysis of VOC	ISO 16000-6:2021, EN 16516:2017+A1:2020	71M542808B	1 µg/m³	ATD-GC/MS	10%
Sampling of aldehydes	ISO 16000-3:2011, EN 16516:2017+A1:2020	71M549812	35 L	DNPH	-
Analysis of aldehydes	ISO 16000-3:2011, EN 16516:2017+A1:2020	71M548400	3-6 µg/m³	HPLC-UV	10%
Sampling of phthalates*	ISO 16000-33:2017, MEL-09:2003	71M549812	60 L	XAD-2	-
Analysis of phthalates*	ISO 16000-33:2017	71M546060	0.6 µg/m³	GC/MS	10%

4 Test Parameters, Sample Preparation and Deviations

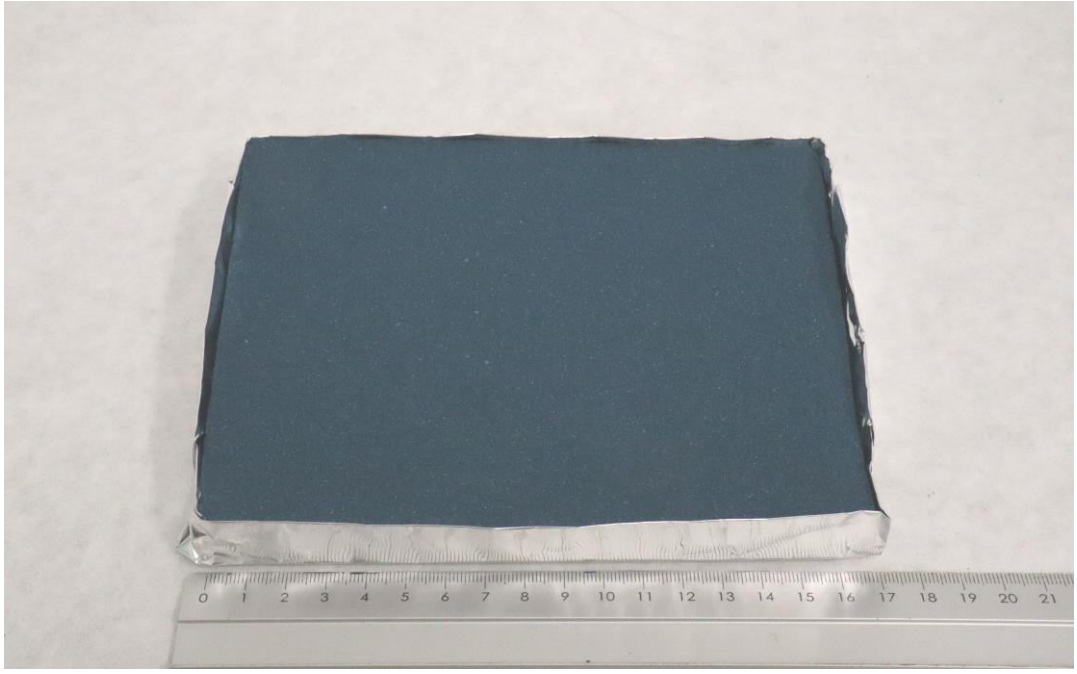
4.1 VOC Emission Chamber Test Parameters

Parameter	Value	Parameter	Value
Chamber volume, V[L]	119	Preconditioning period	-
Air Change rate, n[h^{-1}]	0.5	Chamber test period	16/03/2022 - 13/04/2022
Area specific ventilation rate, q [m/h or $m^3/m^2/h$]	2.5	Analytical test period	16/03/2022 - 21/04/2022
Relative humidity of supply air, RH [%]	50 ± 3	Loading factor [m^2/m^3]	0.2
Temperature of supply air, T [°C]	23 ± 1	Test scenario	

4.2 Preparation of the Test Specimen

Edges and back were covered with aluminium foil.

4.3 Picture of Sample



4.4 Deviations from Referenced Protocols and Regulations

The loading factor of 0.2 m^2/m^3 was chosen by the client and deviates from the loading scenarios described in EN 16516. Consequently the product might not pass the requirements with the loading scenario specified for certain regulations and protocols referenced.

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_D	R_B
VOC with NIK/LCI								
n-Hexane	110-54-3	2.02	1	9.8	< 5	24	0.0023	0.0023
Methylcyclopentane *	96-37-7	2.21	1	16	< 5	41	0.0012	0.0012
VOC without NIK/LCI								
None determined								
Sum of VOC without NIK/LCI				< 5	< 5	< 20		
VVOC compounds								
None determined								
TVVOC				< 5	< 5	< 20		
SVOC compounds								
None determined								
TSVOC				< 5	< 5	< 20		
Carcinogens								
Total carcinogens				< 1	< 1	< 3		
Aldehydes								
Formaldehyde	50-00-0		1	< 3		< 8		
Acetaldehyde	75-07-0		1	< 3		< 8		
Propionaldehyde	123-38-6		1	< 3		< 8		
Butyraldehyde	123-72-8		1	< 3		< 8		
Acrolein *	107-02-8		1	< 5		< 20		
2-Butenal *	123-73-9		1	< 5		< 20		
Glutaraldehyde *	111-30-8		1	< 5		< 20		
Octanal *	124-13-0		1	< 5		< 20		
Nonanal *	124-19-6		1	< 5		< 20		
Decanal *	112-31-2		1	< 5		< 20		
R-values							0.0035	0.0035
TVOC				26	< 5	65		

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_D	R_B
VOC with NIK/LCI								
None determined								
VOC without NIK/LCI								
None determined								
Sum of VOC without NIK/LCI				< 5	< 5	< 20		
VVOC compounds								
None determined								
TVVOC				< 5	< 5	< 20		
SVOC compounds								
None determined								
TSVOC				< 5	< 5	< 20		
Carcinogens								
Total carcinogens				< 1	< 1	< 3		
CMR (French reg.)								
Benzene	71-43-2		1	< 1		< 3		
Trichloroethylene	79-01-6		1	< 1		< 3		
Dibutylphthalate (DBP)*	84-74-2		1	< 1		< 3		
Diethylhexylphthalate (DEHP)*	117-81-7		1	< 1		< 3		
Aldehydes								
Formaldehyde	50-00-0		1	< 3		< 8		
Acetaldehyde	75-07-0		1	< 3		< 8		
Propionaldehyde	123-38-6		1	< 3		< 8		
Butyraldehyde	123-72-8		1	< 3		< 8		
Acrolein *	107-02-8		1	< 5		< 20		
2-Butenal *	123-73-9		1	< 5		< 20		
Glutaraldehyde *	111-30-8		1	< 5		< 20		
Octanal *	124-13-0		1	< 5		< 20		
Nonanal *	124-19-6		1	< 5		< 20		
Decanal *	112-31-2		1	< 5		< 20		
R-values							0	0

	CAS No.	Retention time [min]	ID-Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Specific SER [µg/(m²·h)]	R_D	R_B
TVOC				< 5	< 5	< 20		
TVOC (French label)					< 2			
Toluene	108-88-3			< 2	< 2	< 5		
Tetrachloroethylene	127-18-4			< 2	< 2	< 5		
Ethylbenzene	100-41-4			< 2	< 2	< 5		
Xylene	1330-20-7			< 2	< 2	< 5		
Styrene	100-42-5			< 2	< 2	< 5		
2-Butoxyethanol	111-76-2			< 2	< 2	< 5		
1,2,4-Trimethylbenzene	95-63-6			< 2	< 2	< 5		
1,4-Dichlorobenzene	106-46-7			< 2	< 2	< 5		

The results are only valid for the tested sample(s).
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6 Summary and Evaluation of the Results

6.1 Comparison with Limit Values of the French VOC Regulation

	CAS No.	Conc. 28 days µg/m³	C µg/m³	B µg/m³	A µg/m³	A+ µg/m³
TVOC	-	< 2	> 2000	< 2000	< 1500	< 1000
Formaldehyde	50-00-0	< 3	> 120	< 120	< 60	< 10
Acetaldehyde	75-07-0	< 3	> 400	< 400	< 300	< 200
Toluene	108-88-3	< 2	> 600	< 600	< 450	< 300
Tetrachloroethylene	127-18-4	< 2	> 500	< 500	< 350	< 250
Ethylbenzene	100-41-4	< 2	> 1500	< 1500	< 1000	< 750
Xylene	1330-20-7	< 2	> 400	< 400	< 300	< 200
Styrene	100-42-5	< 2	> 500	< 500	< 350	< 250
2-Butoxyethanol	111-76-2	< 2	> 2000	< 2000	< 1500	< 1000
1,2,4-Trimethylbenzene	95-63-6	< 2	> 2000	< 2000	< 1500	< 1000
1,4-Dichlorobenzene	106-46-7	< 2	> 120	< 120	< 90	< 60

The product was assigned a VOC emission class without taking into account the measurement uncertainty associated with the result. As specified in French Decree no. 2011-321 of March 23 2011, correct assignment of the VOC emission class is the sole responsibility of the party responsible for distribution of the product in the French market.

6.2 Comparison with Limit Values of the CMR Components

CMR (French reg.)	CAS No.	Conc. 28 days µg/m³	Max. allowed air concentration µg/m³
Benzene	71-43-2	< 1	< 1
Trichloroethylene	79-01-6	< 1	< 1
Dibutylphthalate (DBP)*	84-74-2	< 1	< 1
Diethylhexylphthalate (DEHP)*	117-81-7	< 1	< 1

6.3 Comparison with Limit Values of the Italian CAM Regulation

	CAS No.	Conc. 28 days µg/m³	Limit value 28 days µg/m³
TVOC	-	< 2	< 1500
Formaldehyde	50-00-0	< 3	< 60
Acetaldehyde	75-07-0	< 3	< 300
Toluene	108-88-3	< 2	< 450
Tetrachloroethylene	127-18-4	< 2	< 350
Ethylbenzene	100-41-4	< 2	< 1000
Xylene	1330-20-7	< 2	< 300
Styrene	100-42-5	< 2	< 350
2-Butoxyethanol	111-76-2	< 2	< 1500
1,2,4-Trimethylbenzene	95-63-6	< 2	< 1500
1,4-Dichlorobenzene	106-46-7	< 2	< 90
Benzene	71-43-2	< 1	< 1
Trichloroethylene	79-01-6	< 1	< 1
Dibutylphthalate (DBP)*	84-74-2	< 1	< 1
Diethylhexylphthalate (DEHP)*	117-81-7	< 1	< 1

The product was assigned a VOC emission class without taking into account the measurement uncertainty associated with the result.

6.4 Comparison with Limit Values of AgBB/ABG

Parameter	Test after 3 days		Test after 28 days	
	Concentration mg/m³	Limit Value mg/m³	Concentration mg/m³	Limit Value mg/m³
TVOC	0.026	≤ 10	< 0.005	≤ 1.0
TSVOC	< 0.005	-	< 0.005	≤ 0.1
R-value (dimensionless)	0.0035	-	0	≤ 1
Sum of VOC without NIK/LCI	< 0.005	-	< 0.005	≤ 0.1
Formaldehyde	-	-	< 0.003	≤ 0.1
Total carcinogens	< 0.001	≤ 0.01	< 0.001	≤ 0.001

Compliance with the limits alone does not replace an approval or voluntary documentation by a Technical Assessment Body according to the Construction Product Regulation. This requires an application and approval. See www.eurofins.com/dibt-procedures.

6.5 Comparison with Limit Values of the Belgian Regulation

Parameter	Test after 28 days	
	Concentration µg/m³	Limit Value µg/m³
TVOC (EN 16516)	< 5	≤ 1000
TSVOC	< 5	≤ 100
R-value (dimensionless)	0	≤ 1
Total carcinogens	< 1	≤ 1
Toluene	< 5	≤ 300
Formaldehyde	< 3	≤ 100
Acetaldehyde	< 3	≤ 200

6.6 Comparison with Limit Values of LEED v4.1 BETA

Parameter	Test after 28 days	
	Concentration µg/m³	Limit Value µg/m³
TVOC	< 5	≤ 1000
Sum of VOC without NIK/LCI	< 5	< 100
Formaldehyde	< 3	≤ 10
R-value (dimensionless)	0	≤ 1

6.7 Comparison with Limit Values of BREEAM International

Parameter	Concentration mg/m³	Basic Level mg/m³	Exemplary Level mg/m³
Formaldehyde 28 days	< 0.003	≤ 0.06	≤ 0.01
TVOC (EN 16516) 28 days	< 0.005	≤ 1.0	≤ 0.3
TSVOC 28 days	< 0.005	-	≤ 0.1
total carcinogens 28 days	< 0.001	≤ 0.001	≤ 0.001

6.8 Comparison with Limit Values of Indoor Air Comfort®

	Test after 3 days		Test after 28 days	
	Concentration µg/m³	Limit Value µg/m³	Concentration µg/m³	Limit Value µg/m³
TVOC (EN 16516)	< 5	≤ 10000	< 5	≤ 1000
TSVOC	< 5	-	< 5	≤ 100
R_D-value (NIK) (dimensionless)	0.0035	-	0	≤ 1
R_B-value (LCI) (dimensionless)	0.0035	-	0	≤ 1
Sum of VOC without NIK/LCI	< 5	-	< 5	≤ 100
Total carcinogens	< 1	≤ 10	-	-
Any individual carcinogens	-	-	< 1	≤ 1
CMR (French reg.)	-	-	< 1	≤ 1
Formaldehyde	< 3	-	< 3	≤ 60
Acetaldehyde	< 3	-	< 3	≤ 200
French A+/A	-	-	Complies	

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.

6.9 Comparison with Limit Values of Indoor Air Comfort Gold®

	Test after 3 days		Test after 28 days	
	Concentration µg/m³	Limit Value µg/m³	Concentration µg/m³	Limit Value µg/m³
TVOC (EN 16516)	< 5	≤ 1000	< 5	≤ 100
TSVOC	< 5	-	< 5	≤ 20
R_D-value (NIK) (dimensionless)	0.0035	-	0	≤ 1
R_B-value (LCI) (dimensionless)	0.0035	-	0	≤ 1
Sum of VOC without NIK/LCI	< 5	-	< 5	≤ 50
Total carcinogens	< 1	≤ 10	-	-
Any individual carcinogens	-	-	< 1	≤ 1
CMR (French reg.)	-	-	< 1	< 1
Formaldehyde	< 3	-	< 3	< 10
Acetaldehyde	< 3	-	< 3	< 200
French A+	-	-	Complies	

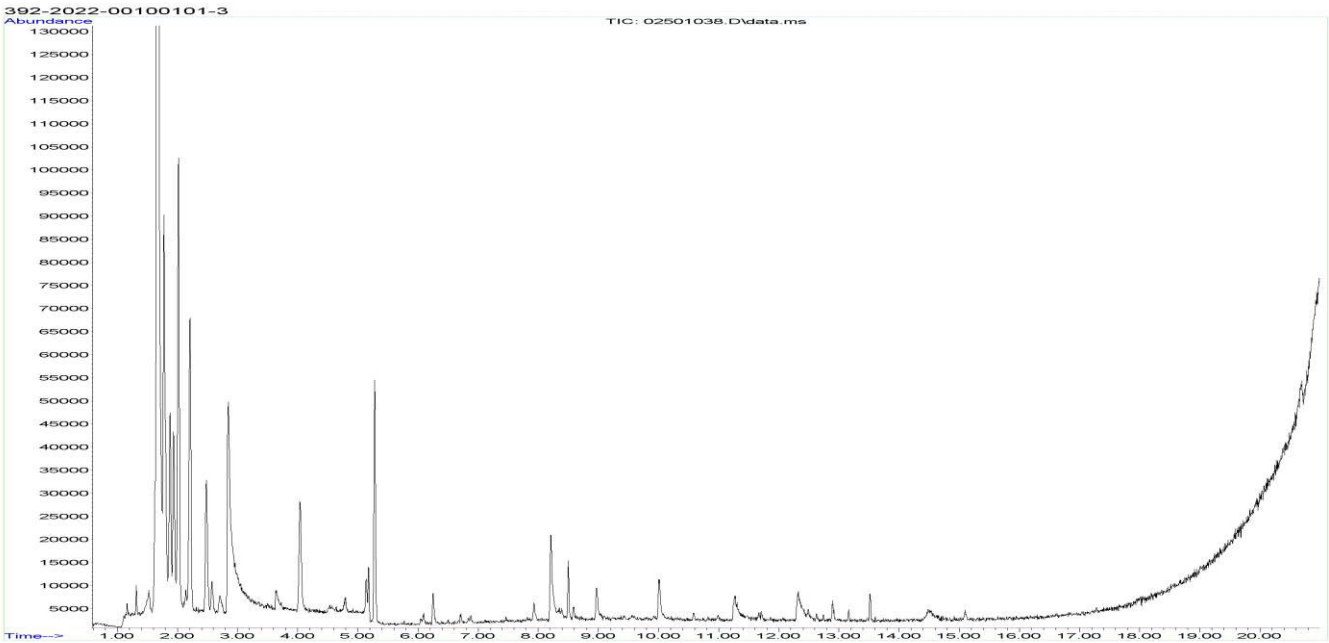
Compliance with the limits alone does not entitle to use the Indoor Air Comfort GOLD label. This requires an application, site inspection, and approval. See www.eurofins.com/iac-procedures.

6.10 Comparison with Limit Values of Blue Angel (DE-UZ 132)

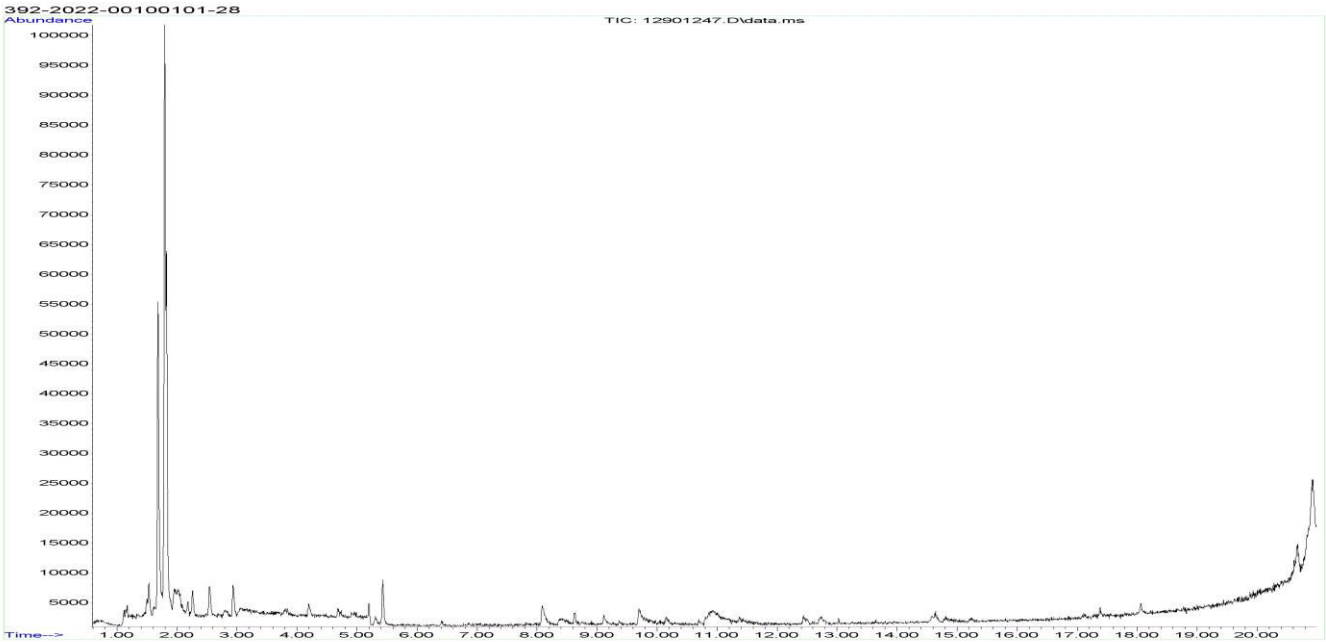
	Test after 28 days	
	Concentration µg/m³	Limit Value µg/m³
TVOC w/o acetic acid	< 5	≤ 100
TSVOC	< 5	≤ 20
Acetic acid	< 5	≤ 140
R-value (dimensionless)	0	≤ 1
Sum of VOC without NIK/LCI	< 5	≤ 50
Any individual carcinogens	< 1	≤ 1
Formaldehyde	< 3	≤ 60
Acetaldehyde	< 3	≤ 120

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.

7.3 How to Understand the Results

7.3.1 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 substrate and is thus removed
c	The results have been corrected by the emission from the substrate
d	Very polar organic compounds are not suitable for reliable quantification using Tenax TA adsorbent and HP-5ms 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

7.3.2 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.

7.4 Applied LCI and NIK Values

7.4.1 LCI/NIK Values for Compounds found after 3 Day Measurements

Compound	CAS No.	AgBB 2021 NIK [µg/m³]	Belgian NIK [µg/m³]
n-Hexane	110-54-3	4300	4300
Methylcyclopentane *	96-37-7	14000	14000

7.4.2 LCI/NIK Values for Compounds found after 28 Day Measurements

Compound	CAS No.	AgBB 2021 NIK [µg/m³]	Belgian NIK [µg/m³]
None determined	-	-	-

7.5 Description of VOC Emission Test

7.5.1 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).

7.5.2 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).

7.5.3 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 µm 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).

7.5.4 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, 0.25µm 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-1):

- 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 ≥ 5 µg/m³. 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 ≥ 5 µg/m³, 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 ≥ 5 µg/m³ 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).

7.5.5 Calculation of R Values with LCI Lists

The concentrations of detected compounds ≥ 5 µg/m³ 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:

$$R = \sum_{i}^{n} \left({}^{c_i}\!/_{NIK_i} + \ldots + {}^{c_n}\!/_{NIK_n} \right)$$

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 ≥ 5 µg/m³ are summed up as sum of VOCs without LCI/NIK if required by the standard or protocol.

7.5.6 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.

7.5.7 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).

7.6 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.

7.7 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).

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.

7.8 Uncertainty of the Test Method

The relative standard deviation of the overall analysis is 22%. The expanded uncertainty Um equals 2 x RSD. For further information please visit www.eurofins.dk/uncertainty.

7.9 Decision Rules

Eurofins Product Testing A/S, declare statement of conformity based on the “Binary Statement for Simple Acceptance Rule” described in ILAC’s “Guidelines on decision Rules and Statements of Conformity” ILAC-G8:09/2019.

This means that results above the detection limit are always reported with two significant digits. Results are evaluated with the same number of significant digits as the corresponding limit values, and conformity is based on results being less than or equal to limit values.

For limit values with more than two significant digits, the third digit will be used to confirm whether a result is below or equal to the limit value. It will always be indicated in the evaluation table if this expanded evaluation is performed.

For further information please visit www.eurofins.dk/product-testing/om-os/beslutningsregler/

7.10 Version History

Report date	Report number	Modification
28/04/2022	392-2022-00100101_A_EN_rev1	Addition of Armacell no. to sample name. This version is considered valid.
21/04/2022	392-2022-00100101_A_EN	This versions is no longer valid.