ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	DBC, EFCC, FEICA, IVK
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
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Declaration number	EPD-DBC-20220180-IBF1-EN
Issue date	31/08/2022
Valid to	30/08/2027

Silicone-based products, group 2

DBC - Deutsche Bauchemie e.V.

EFCC - European Federation for Construction Chemicals

FEICA - Association of the European Adhesive and Sealant Industry

IVK - Industrieverband Klebstoffe e.V.

Institut Bauen und Umwelt e.V.

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DEUTSCHE BAUCHEMIE

EFCC

FEICA®

Industrieverband Klebstoffe e.V.

1. General Information

DBC - Deutsche Bauchemie e.V.
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Silicone-based products, group 2

Programme holder
IBU – Institut Bauen und Umwelt e.V.
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EFCC, 172 Boulevard du Triomphe, B-1160 Brussels
FEICA, Rue Belliard 40, B-1040 Brussels
IVK, Völklingerstr. 4, D-40219 Düsseldorf

Declaration number
EPD-DBC-20220180-IBF1-EN

Declared product / declared unit
1 kg silicone-based product, group 2; density 1.0 - 1.5 g/cm³

This declaration is based on the product category rules:
Building sealants, 07.2014
(PCR checked and approved by the SVR)

Scope:
This verified EPD entitles the holder to bear the symbol of the Institut Bauen und Umwelt e.V. It exclusively applies for products produced in Europe and for a period of five years from the date of issue. This EPD may be used by members of DBC, EFCC, FEICA and IVK and their members provided it has been proven that the respective product can be represented by this EPD. For this purpose, a guideline is available at the secretariats of the four associations. The members of the associations are listed on their respective websites.

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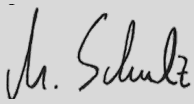
The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
The EPD was created according to the specifications of *EN 15804+A2*. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard *EN 15804* serves as the core PCR
Independent verification of the declaration and data according to *ISO 14025:2011*
☐ internally ☒ externally

Dipl. Ing. Hans Peters
(chairman of Institut Bauen und Umwelt e.V.)

Dr. Alexander Röder
(Managing Director Institut Bauen und Umwelt e.V.))



Matthias Schulz
(Independent verifier)

2. Product

2.1 Product description/Product definition

Silicone-based products, group 2 with a Volatile Organic Compound (VOC) content ≤2 % (VOC definition according to *Decopaint Directive*) are manufactured from reactive siloxane and so-called silicone oil, optionally by using fillers, extenders, colour pigments, cross-linkers, bonding agents and catalysts. For most of the applications the products are formulated as moisture-reactive one-component systems; for industrial applications there are also two-component systems available. They permanently and elastically seal joints planned for the building. Silicone-based products fulfil key functions. Ingress of moisture into the structure via the joints is prevented by joint sealants. With the use of silicone-based products, the fitness for use of the building and the service life are decisively extended. The product displaying the highest environmental impacts was used as a representative product for calculating the Life Cycle Assessment results (worst-case approach).

For the placing on the market in the European Union/European Free Trade Association (EU/EFTA) with the exception of Switzerland) products falling under the Regulation (EU) No 305/2011 (*CPR*) need a

Declaration of Performance taking into consideration either the relevant harmonised European standard or the European Technical Assessment and the CE marking. For the application and use of the products the respective national provisions apply.

2.2 Application

Module 1: Façade sealants
Silicone-based products are used for the elastic sealing of joints. The areas of application for façade sealants include expansion joints (movement joints) and/or connection joints already existing in exterior walls and on window and door frames (including the inside section). All these sealants fulfil key functions of the building.

Module 2: Sealants for glazing
Silicone-based products are used for the elastic sealing of joints which may be subject to movement. Sealants for glazing are used in the following areas: (i)Glass to glass (ii)Glass to frame (iii)Glass to porous substrates

Module 3: Sanitary sealants
The areas of application for silicone-based sanitary sealants are joints in sanitary areas and kitchens. Joints sealed using sanitary sealants comprise connection joints between sanitary furnishings and the wall, connection joints between the floor and wall or movement joints across surfaces, for example.

Module 4: Sealants for pedestrian walkways
The areas of application for silicone-based sealants for pedestrian walkways are floor joints designed for pedestrian walkways, public areas, movement joints between concrete slabs, areas with pedestrian load, areas used with trolleys, walkable floors, balconies, terraces, warehouses.

Module 5: Bonded glazing sealants
One- and two-component structural sealants are to be used in a structural sealant glazing system (SSGK) to bond glazing products to metallic structural seal support frames and/or as the second barrier of the structural hermetic seal in insulating glass units.

2.3 Technical Data

The density of the products is between 1,00 and 1,50 g/cm³, other relevant technical data can be found in the manufacturer's technical documentation.

Module 1: Façade sealants
The minimum requirements on water and airtightness as per Table ZA.1 of *EN 15651-1* apply: see table

Module 2: Sealants for glazing
The minimum requirements on water and airtightness as per Table ZA.1 of *EN 15651- 2* apply: see table

Module 3: Sanitary sealants
The minimum requirements on water and airtightness as per Table ZA.1 of *EN 15651-3* apply: see table

Module 4: Sealants for pedestrian walkways
The minimum requirements on water and airtightness as per Table ZA.1 of *EN 15651-4* apply: see table

Module 5: Bonded glazing sealants
Structural Sealants must comply with *ETAG 002-1* used as EAD.

Constructional data

Name	Value	Unit
Elastic recovery EN ISO 7389	only for module 2: >/=25 or >/=100	%
Loss of volume EN ISO 10563	value to be declared by the manufacturer	%
Resistance to flow EN ISO 7390	only for module 1,2 and 3; value to be declared by the manufacturer	mm
Tensile properties EN ISO 8339	only for module 1, 3 and 4: </=0,9	
Adhesion/cohesion properties at maintained extension after immersion in water EN ISO 10590	only for module 1 and 4: NF*	
Adhesion/cohesion properties after immersion in water plastic sealants EN ISO 10591	only for module 1: >/=25 or >/=100	%
Adhesion/cohesion properties after exposure to heat, water and artificial light EN ISO 11431	only for module 2:NF*	
Adhesion/cohesion properties at maintained extension after immersion in water for sealants in class XS and/or adhesion/cohesion properties after immersion in water for sealants in class S EN ISO 10590	only for module 3 and 4: NF*	
Adhesion/cohesion properties at maintained extension after 28 days salt water immersion	only for module 4**: NF*	

* NF: Passed-Failed criteria. The sealant class must also be indicated for the declared product.
** not required for interior use
valid for all modules: Other performance characteristics in accordance with the manufacturer's technical documentation/declaration of performance

2.4 Delivery status

Pasty in containers made of plastic, foil or metal. Typical container sizes contain 50 ml to 1000 ml of product. A combination of HDPE (high-density polyethylene) cartridges, cardboard and pallets was modelled for the LCA. For one and two component bonded glazing sealants (Module 5) 200 l metal drums and plastic or metal 20 l pails are used as containers.

2.5 Base materials/Ancillary materials

Silicone-based products, group 2 are manufactured from reactive siloxane and silanes, sometimes using fillers. The cross-linking reaction occurs through the effects of humidity in the air when installed. **Typically**, the products covered by this EPD contain the following range of base materials and auxiliaries (% by mass):

Siloxanes: 45-90
Silanes: 2-10
Silicone plasticizers: 0-30
Mineral fillers: 0-50
Fumed silica: 0-20
Mineral oil/Solvent: 0-30
Pigments: 0-20
Water: 0-20
Additives: <5
VOC according to *Decopaint Directive:* ≤2 % (**mandatory**)

These ranges are average values and the composition of products complying with the EPD can deviate from these concentration levels in individual cases. More detailed information is available in the respective manufacturer's documentation (e.g. product data sheets).

Note: For companies to declare their products within the scope of this EPD it is not sufficient to simply comply with the product composition shown above. The application of this EPD is only possible for member companies of DBC, EFCC, FEICA, and IVK member associations and only for specific formulations with a total score below the declared maximum score for a product group according to the associated guidance document.

1. substances from the "Candidate List of Substances of Very High Concern for Authorisation" (SVHC)
If this product contains substances listed in the *candidate list* (latest version) exceeding 0.1 percentage by mass, the relevant information can be found in the safety data sheet of the relevant product covered by this model EPD.
2. CMR substances in categories 1A and 1B
If this product contains other carcinogenic, mutagenic, reprotoxic (CMR) substances in categories 1A or 1B which are not on the *candidate list*, exceeding 0.1 percentage by mass, the relevant information can be found in the safety data sheet of the relevant product covered by this model EPD.
3. Biocide products added to the construction product
If this construction product contains biocide products, the active substances, information on the concentration and/or concentration range, the product type together with information on their hazardous properties are listed in the safety data sheet of the respective product.

2.6 Manufacture
Silicone-based products are generally manufactured by mixing the ingredients and then filling them into the delivery containers.

2.7 Environment and health during manufacturing
As a general rule, no other environmental or health protection measures other than those specified by law are necessary.

2.8 Product processing/Installation
One-component silicone-based products are usually processed manually on site using suitable tools. In most cases, the products are inserted into joints using cartridge guns, whereby health and safety measures (gloves and goggles, ventilation) are to be taken and consistently adhered to in accordance with the information on the safety data sheet and conditions on site. VOC emissions may occur. Two-component silicone products are processed on the job site by using mix cartridges with static mixers. On the shop floor, two-component dosing & mixing equipment is used (static or dynamic mixers) and the mixed product can be applied manually or fully automatically by a sealing robot.

2.9 Packaging
A detailed description of packaging is provided in section 2.4. Empty containers and clean foils can be recycled.

2.10 Condition of use
During the use phase, silicone-based products are fully cross-linked and hardened. They are durable products which protect buildings and significantly contribute towards their appearance, function and long-term value.

2.11 Environment and health during use
Option 1 – Products for applications outside indoor areas with permanent stays by people
During use, silicone-based products lose their reactive capacity and are inert. No risks are known for water, air and soil if the products are used as designated.

Option 2 – Products for applications inside indoor areas with permanent stays by people
When used in indoor areas with permanent stays by people, evidence of the emission performance of construction products in contact with indoor air must be submitted according to national requirements. No further influences on the environment and health by emanating substances are known.

2.12 Reference service life
Sealants fulfil key functions in buildings. They decisively improve the usability of building structures and significantly extend their original service lives. Information supplied by the manufacturer on maintenance and care must be observed.

2.13 Extraordinary effects

Fire
Even without any special fire safety features, joint sealants comply with at least the requirements of *EN 13501-1* for fire class E. In terms of volumes used, sealants generally have no or only a minor influence on the fire characteristics (e.g. smoke gas development) of the building in which they are applied.

Water
Silicone-based products are insoluble in water. They are often used to protect building structures from harmful water ingress or the effects of flooding.

Mechanical destruction
The mechanical destruction of silicone-based products does not lead to any decomposition products which are harmful to the environment or health.

2.14 Re-use phase
According to present knowledge, no environmentally hazardous effects in terms of landfilling are to be

generally anticipated through dismantling and recycling of components to which hardened silicone sealants adhere.

2.15 Disposal

Silicone-based products which cannot be recycled can be hardened. Empty containers are directed to the recycling process. Only a low volume of silicone sealants is incurred in the disposal of components in which they are used. Low levels of adhesion do not play any role in terms of disposal. They do not impair the disposal/recycling of other components/building materials. Hardened residual product mechanically removed from substrates must be disposed of as commercial/site waste. The following waste codes according to the European List of Waste (EWC) (*2000/532/EC*) can apply:
Product residue: EWC 08 04 09
EWC 08 04 10 with the exception of those covered by EWC 08 04 09

2.16 Further information

More information is available on the manufacturer's product or safety data sheets and is available on the manufacturer's websites or on request. Valuable technical information is also available on the associations' websites.

3. LCA: Calculation rules

3.1 Declared Unit

This EPD refers to the declared unit of 1 kg of silicone-based product, group 2; applied into the building with a density of 1.0 - 1.5 g/cm³ in accordance with the IBU *PCR part B* for construction sealant.
The results of the Life Cycle Assessment provided in this declaration have been selected from the product with the highest environmental impact (worst-case scenario).
Depending on the application, a corresponding conversion factor such as the density to convert volumetric use to mass must be taken into consideration.

The Declaration type is according to *EN 15804*: Cradle to gate with options, modules C1–C3, and module D (A1–A3, C, D) and additional modules (A4-A5).

Declared unit

Name	Value	Unit
Declared unit	1	kg
Gross density	1-1.5	g/cm^3

3.2 System boundary

Modules A1, A2 and A3 are taken into consideration in the LCA:
- A1 Production of preliminary products
- A2 Transport to the plant
- A3 Production incl. provision of energy, production of packaging as well as auxiliaries and consumables and waste treatment
- A4 Transport to site
- A5 Installation, product applied into the building during A5 phase operations and packaging disposal. This stage considers VOC emissions during the installation phase. The declared product contain substances in(to) the formulation that directly emit as VOC. VOCs are even generated by a chemical reaction that is occurring during this phase.
The end of life for the packaging material considered is described below:
  -Incineration, for materials like plastic, paper and wood.
-C1-C2-C3-D
The building deconstruction (demolition process) takes place in the C1 module which considers energy generation and consumption of diesel and all the emissions connected with the fuel-burning process to run the machines. After the demolition, the product is transported to the end-of-life processing (C2 module) where all the impacts related to the transport processes are considered. For precautionary principle and as a worst-case scenario, thermal treatment is the only end-of-life scenario considered. This is modelled by the incineration process (module C3) where the product ends its life cycle.
Module D accounts for potential benefits that are beyond the defined system boundaries. Credits are generated during the incineration of wastes and related electricity produced that are occurring in the A5 module.

3.3 Estimates and assumptions

For this EPD formulation and production data defined and collected by FEICA were considered. Production waste was assumed to be disposed of by incineration without credits as a worst-case for recovered thermal energy (recovered electricity is looped back within module A1-A1).
An average of plastic containers and wooden pallets was considered in the LCA.

3.4 Cut-off criteria

All raw materials submitted for the formulations and production data were taken into consideration.
The manufacture of machinery, plant and other infrastructure required for the production of the products under review was not taken into consideration in the LCA.
Transport of packaging materials is excluded.

3.5 Background data

Data from the *GaBi* database SP40 (2020) was used as background data.

3.6 Data quality

Representative products were applied for this EPD and the product in the group displaying the highest environmental impact was selected for calculating the LCA results. The background datasets used are less than 4 years old.
Production data and packaging are based on details provided by the manufacturer. The formulation used for evaluation refers to a specific product.
The data quality of the background data is considered to be good.

3.7 Period under review

Representative formulations are valid for 2021.

3.8 Allocation

Mass allocation has been applied when primary data have been used and implemented into the LCA model.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken into account.

The *GaBi* database SP40 (2020) was used.

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic Carbon
The packaging material contain biogenic carbon which is presented below.

Information on describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic Carbon Content in product	-	kg C
Biogenic Carbon Content in accompanying packaging	0.024	kg C

For the preparation of building life cycle assessments, it must be taken into account that in module A5 (installation in the building) the biogenic amount of CO2 (0.024 kg C *3.67 = 0.088 kg CO2-eq.) of the packaging bound in module A1-A3 is mathematically booked out.

Transport to the building site (A4)

Name	Value	Unit
Transport distance	1000	km
Gross weight	34 - 40	t
Payload capacity	27	t

Installation into the building (A5)

Name	Value	Unit
Other resources for packaging material	0.225	kg
Material loss	0.01	kg

Material loss considers the amount of product not used during the application phase into the building. This amount is 1 % of the product and, impacts related to the production of this part are assigned to the A5 module. This percentage is considered as waste to disposal and impacts of its end of life have been considered in the LCA model and declared in A5.

End of life (C1-C4)

Name	Value	Unit
Collected as mixed construction waste	0.98	kg
Incineration	0.98	kg

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	ND	ND	MNR	MNR	MNR	ND	ND	X	X	X	ND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 kg of silicone-based product, group 2

Core Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	D
GWP-total	[kg CO_2-Eq.]	6.82E+0	5.87E-2	6.91E-1	2.73E-4	1.21E-2	4.55E-1	-6.18E-1
GWP-fossil	[kg CO_2-Eq.]	6.91E+0	5.81E-2	5.77E-1	2.61E-4	1.16E-2	4.21E-1	-6.17E-1
GWP-biogenic	[kg CO_2-Eq.]	-9.86E-2	1.70E-4	1.15E-1	1.21E-5	5.31E-4	3.46E-2	-1.42E-3
GWP-luluc	[kg CO_2-Eq.]	6.96E-3	4.70E-4	7.39E-5	6.27E-9	2.74E-7	3.43E-5	-4.07E-4
ODP	[kg CFC11-Eq.]	2.08E-13	6.98E-18	2.14E-15	2.78E-20	1.21E-18	2.96E-16	-6.05E-15
AP	[mol H^+-Eq.]	2.96E-2	1.74E-4	3.70E-4	3.53E-6	3.66E-5	5.15E-4	-8.36E-4
EP-freshwater	[kg P-Eq.]	1.16E-5	1.77E-7	1.25E-7	5.64E-11	2.46E-9	1.02E-7	-7.49E-7
EP-marine	[kg N-Eq.]	4.76E-3	7.75E-5	6.65E-5	1.60E-6	1.68E-5	1.97E-4	-2.19E-4
EP-terrestrial	[mol N-Eq.]	5.19E-2	8.68E-4	8.67E-4	1.75E-5	1.85E-4	2.47E-3	-2.35E-3
POCP	[kg NMVOC-Eq.]	1.91E-2	1.53E-4	2.97E-2	4.81E-6	3.32E-5	5.11E-4	-6.32E-4
ADPE	[kg Sb-Eq.]	2.17E-4	4.16E-9	2.17E-6	7.90E-12	3.45E-10	4.52E-9	-9.70E-8
ADPF	[MJ]	1.25E+2	7.73E-1	1.34E+0	3.73E-3	1.63E-1	5.41E-1	-1.04E+1
WDP	[m^3 world-Eq deprived]	2.24E+0	5.19E-4	8.22E-2	5.16E-7	2.25E-5	1.54E-1	-6.01E-2

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 kg of silicone-based product, group 2

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	D
PERE	[MJ]	5.03E+1	4.35E-2	1.43E+0	1.18E-5	5.14E-4	9.18E-2	-2.15E+0
PERM	[MJ]	9.05E-1	0.00E+0	-9.05E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	5.12E+1	4.35E-2	5.30E-1	1.18E-5	5.14E-4	9.18E-2	-2.15E+0
PENRE	[MJ]	1.05E+2	7.74E-1	8.96E+0	3.74E-3	1.63E-1	1.34E+1	-1.04E+1
PENRM	[MJ]	2.04E+1	0.00E+0	-7.62E+0	0.00E+0	0.00E+0	-1.28E+1	0.00E+0
PENRT	[MJ]	1.25E+2	7.74E-1	1.34E+0	3.74E-3	1.63E-1	5.41E-1	-1.04E+1
SM	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	6.92E-2	5.03E-5	2.09E-3	2.11E-8	9.22E-7	3.63E-3	-2.49E-3

Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 kg of silicone-based product, group 2

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	D
HWD	[kg]	9.98E-7	3.60E-8	1.01E-8	3.63E-13	1.58E-11	1.73E-9	-4.15E-9
NHWD	[kg]	1.72E+0	1.18E-4	2.19E-2	3.82E-7	1.67E-5	1.34E-1	-4.68E-3
RWD	[kg]	5.16E-3	9.58E-7	5.69E-5	4.01E-9	1.75E-7	2.46E-5	-7.33E-4
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	1.24E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	2.22E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EEE = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 kg of silicone-based product, group 2

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	D
PM	[Disease Incidence]	ND	ND	ND	ND	ND	ND	ND
IRP	[kBq U235-Eq.]	ND	ND	ND	ND	ND	ND	ND
ETP-fw	[CTUe]	ND	ND	ND	ND	ND	ND	ND
HTP-c	[CTUh]	ND	ND	ND	ND	ND	ND	ND
HTP-nc	[CTUh]	ND	ND	ND	ND	ND	ND	ND
SQP	[-]	ND	ND	ND	ND	ND	ND	ND

Caption	PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Potential Human exposure efficiency relative to U235, Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and (from) some construction materials is also not measured by this indicator.

ADP minerals & metals, ADP fossil, WDP, ETF-fw, HTP-c, HTP-nc, SQP, Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

Additional environmental impact indicators (suggested by *EN15804*, table 4) are not declared in the EPD. The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high and as there is limited experience with the indicator (see ILCD classification in *EN 15804*, table 5). For this reason, results based on these indicators are not considered suitable for a decision-making process and are thus not declared in the EPD.

6. LCA: Interpretation

The majority of impacts are associated with the production phase (A1-A3). The most significant contribution to the production phase impacts is the upstream production of raw materials as a main driver. Another contributor in the production phase, in the category of Photochemical ozone formation (POCP), is the plastic used as a packaging material. Emissions associated with the manufacturing of products also have a high influence on Ozone Depletion Potential (ODP) in the production phase. In all EPDs, CO_2 is the most important contributor to Global Warming Potential (GWP). For the Acidification Potential (AP), NOx and SO_2 contribute the largest share.
The majority of life cycle energy consumption takes place during the production phase (A1-A3). Significant contributions to Primary Energy Demand – Non-renewable (PENRT) come from the energy resources used in the production of raw materials. The largest contributor to Primary Energy Demand – Renewable (PERT) impacts comes from the consumption of renewable energy resources required for the generation and supply of electricity. It should be noted that Primary Energy Demand – Renewable (PERT) generally represents a small percentage of the production phase primary energy demand with the bulk of the demand coming from non-renewable energy resources.
Transportation to the construction site (A4) and the installation process (A5) make a low contribution to the overall impacts. Climate change from land use change is the only indicator influenced by transport processes, due to the diesel production used as fuel, because part of this diesel has been produced from bio-based raw materials.
The installation phase influence mainly Photochemical ozone formation indicator, due to the emission of VOC during the operations. These emissions are not only directly related to the pre-products in the resins, but they are related to the reaction products between pre-products and air components (water and oxygen).
The end-of-life phases influence climate change indicators, due to the thermal treatment process of the silicon-based products occurring in the C3 module.

7. Requisite evidence

VOC
Special tests and evidence have not been carried out or provided within the framework of drawing up this Model EPD. Some member states require special documentation on VOC emissions into indoor air for specific areas of application. This documentation, as well as documentation for voluntary VOC labelling, has to be provided separately and is specific to the product in question.

Evidence pertaining to VOC emissions shall show
- either an attestation of compliance with,
- or documentation of test data that are required in any of the existing regulations or in any of the existing voluntary labelling programs for low-emitting products, as far as these

(1) include limits for the parameters TVOC, TSVOC, carcinogens, formaldehyde, acetaldehyde, LCI limits for individual substances (including but not limited to the European list of harmonized LCIs), and the R-value;
(2) base their test methods on *EN 16516*;
(3) perform testing and apply the limits after 28 days of storage in a ventilated test chamber, under the conditions specified in *EN 16516*; some regulations

and programs also have limits after 3 days, on top of the 28 days limits;
(4) express the test results as air concentrations in the European Reference Room, as specified in *EN 16516*.

Examples of such regulations are the *Belgian Royal Decree C-2014/24239*, or the *German AgBB/*ABG. Examples of such voluntary labelling programs are *EMICODE*, *Blue Angel* or *Indoor Air Comfort*.

Relevant test results shall be produced either by an *ISO 17025* accredited commercial test lab or by a qualified internal test lab of the manufacturer.
Examples for the applied limits after 28 days of storage in a ventilated test chamber are:

- TVOC: 1000 µg/m³
- TSVOC: 100 µg/m³
- Each carcinogen: 1 µg/m³
- Formaldehyde: 100 µg/m³
- LCI: different per substance involved
- R-value: 1 (meaning that, in total, 100 % of the combined LCI values must not be exceeded).

Informative Annexes (2 tables):
Table 1 shown below is an overview of the most relevant regulations and specifications as of October 2021, as regards requirements after 3 days of storage in a ventilated test chamber.
Table 2 provides an overview of the most relevant regulations and specifications as of October 2021, as regards requirements after 28 days of storage in a ventilated test chamber. Some details may be missing in the table due to lack of space. Values given represent maximum values/limits.

	TVOC µg/m³	Sum of carcinogens. C1A,CA2 µg/m³	Formaldehyde µg/m³	Acetaldehyde µg/m³	Sum of Form- and Acetaldehyde
German AgBB/ABG regulation	10 000	10	-/-	-/-	-/-
Belgian regulation	10 000	10	-/-	-/-	-/-
EMICODE EC1	1 000	10	50	50	50 ppb
EMICODE EC1 *PLUS*	750	10	50	50	50 ppb

	TVOC µg/m³	TSVOC µg/m³	Each carcinogen C1A,CA2 µg/m³	Formalde-hyde µg/m³	Acetalde-hyde µg/m³	LCI	R value	Specials	Sum of non-LCI & non-identified µg/m³
Belgian regulation	1000	100	1	100	200	Belgian list	1	Toluene 300 µg/m³	-/-
French regulations class A+	1000	-/-	-/-	10	200	-/-	-/-	List of 8 VOCs, 4 CMR	-/-
French regulations class A	1500	-/-	-/-	60	300	-/-	-/-	List of 8 VOCs, 4 CMR	-/-
French regulations class B	2000	-/-	-/-	120	400	-/-	-/-	List of 8 VOCs, 4 CMR	-/-
French regulations class C	>2000	-/-	-/-	>120	>400	-/-	-/-	List of 8 VOCs, 4 CMR	-/-
German DIBt/AgBB regulation	1000	100	1	100	300	German AgBB list	1	-/-	100
EMICODE EC1	100	50	1	(after 3 days)	(after 3 days)	-/-	-/-	-/-	-/-
EMICODE EC1 *PLUS*	60	40	1	(after 3 days)	(after 3 days)	German AgBB list	1	-/-	40
Finnish M1, sealants	20	-/-	1	10	300	EU LCI list	-/-	Ammonia, odour	-/-
Finnish M1, adhesives	200 µg/m²h	-/-	5 µg/m²h	50 µg/m²h	300	EU LCI list	-/-	Ammonia, odour	-/-

8. References

ETAG 002-1
ETAG 002-1:2012 (used as EAD)
Structural Sealant Glazing Kits (SSGK) – Part 1: Supported and unsupported Systems

RAL UZ 123
RAL UZ 123:2019 Basis for awarding the "Low-emission sealants for interiors" environmental certificate

EN ISO 7389
EN ISO 7389:2003 Building construction – Jointing products – Determination of elastic recovery of sealants

EN ISO 7390
EN ISO 7390:2003 Building construction – Jointing products – Determination of resistance to flow of sealants

EN ISO 8339
EN ISO 8339: 2005 Building construction – Sealants – Determination of tensile properties (Extension to break)

EN 10563
EN ISO 10563:2017 Building construction – Sealants – Determination of change in mass and volume

EN ISO 10590
EN ISO 10590:2005 Building construction – Sealants – Determination of tensile properties of sealants at maintained extension after immersion in water

EN ISO 10591
EN ISO 10591:2005 Building construction – Sealants - Determination of adhesion/cohesion properties of sealants after immersion in water

EN ISO 11431
EN ISO 11431:2002 Building construction – Jointing products – Determination of adhesion/cohesion properties of sealants after exposure to heat, water and artificial light through glass

EN 13501-1
EN 13501-1:2018 Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests

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EN 15651-1
EN 15651-1:2012 Sealants for non-structural use in joints in buildings and pedestrian walkways – Part 1: Sealants for façade elements

EN 15651-2
EN 15651-2:2012 Sealants for non-structural use in joints in buildings and pedestrian walkways– Part 2: Sealants for glazing

EN 15651-3
EN 15651-3:2012 Sealants for non-structural use in joints in buildings and pedestrian walkways – Part 3: Sealants for sanitary joints

EN 15651-4
EN 15651-4:2012 Sealants for non-structural use in joints in buildings and pedestrian walkways – Part 4: Sealants for pedestrian walkways

EN 15804
EN 15804+A2:2019+AC:2021, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

EN 16516
EN 16516:2017
Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air

EN ISO 17025
EN ISO 17025: 2018-03
General requirements for the competence of testing and calibration laboratories

2000/532/EC
Commission decision dated 3 May 2000 replacing decision 94/3/EC on a waste directory in accordance with Article 1 a) of Council Directive 75/442/EEC on waste and Council decision 94/904/EC on a directory of hazardous waste in terms of Article 1, paragraph 4 of Directive 91/689/EEC on hazardous waste

Belgian Royal Decree C-2014/24239
Belgisch Staatsblad 8 MEI 2014, p. 60603. — Koninklijk besluit tot vaststelling van de drempelniveaus voor de emissies naar het binnenmilieu van bouwproducten voor bepaalde geoogde gebruiken

Blue Angel
Environmental label organised by the federal government of Germany www.blauer-engel.de

Candidate list
Candidate List of substances of very high concern for Authorisation, published in accordance with Article 59(10) of the REACH Regulation, ECHA, www.echa.europa.eu/candidate-list-table

CPR
CPR Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

Decopaint Directive
Directive 2004/42/CE of the European Parliament and the council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC

EMICODE
EMICODE, GEV – Gemeinschaft Emissionskontrollierte Verlegewerkstoffe, Klebstoffe und Bauprodukte e. V. (pub.).www.emicode.de

GaBi 10
GaBi 10: Software and database for comprehensive analysis. LBP, University of Stuttgart and Sphera, 2020

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Gabi 10: documentation of GaBi 10 data sets from the data base for Life Cycle Engineering LBP, University of Stuttgart and Sphera, http://documentation.gabi-software.com/, 2020

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www.eurofins.com

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Product Category Rules for Building-Related Products and Services, Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project report, Version 1.1, Institut Bauen und Umwelt e.V., 2021-01

PCR Part B
Product Category Rules for Construction Products, Part B: Building sealants, 2019-04

REACH
Directive (EG) No. 1907/2006 of the European Parliament and of the Council dated 18 December 2006 on the registration, evaluation, approval and restriction of chemical substances (REACH), for establishing a European Agency for chemical substances, for amending Directive 1999/45/EC and for annulment of Directive (EEC) No. 793/93 of the Council, Directive (EC) No. 1488/94 of the Commission, Guideline 76/769/EEC of the Council and Guidelines 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC of the Commission.

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