

ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804+A2

Owner of the Declaration	INDURA
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-IND-20230364-CBC1-EN
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Valid to	19/09/2028

Flanges, weld rings and collars of stainless steel INDURA

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General Information

INDURA

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-IND-20230364-CBC1-EN

This declaration is based on the product category rules:

Steel pipes for pressure applications, 01/08/2021
(PCR checked and approved by the SVR)

Issue date

20/09/2023

Valid to

19/09/2028



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



Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

Flanges, weld rings and collars of stainless steel

Owner of the declaration

INDURA
Grønlandsvej 1
7480 Vildbjerg
Denmark

Declared product / declared unit

1 kilogram of flanges, weld rings or collars in stainless steel

Scope:

A life cycle assessment according to *ISO 14040/44* has been conducted individually for 1 kg (worst-case product) of the three product groups:

- Flanges of stainless steel
- Weld rings of stainless steel
- Collars of stainless steel

Due to the variations in products and production locations, the worst-case EPD approach has been applied and the highest environmental impacts have been declared.

The materials and metal shaping processes originate from a multitude of suppliers which INDURA is not in operational control over. The suppliers' locations are mainly China and India. A conservative average approach has been applied to make the EPD representative for the suppliers from different locations, thus Chinese representative data is applied to the calculation in terms of the energy mix and transport distances. INDURAs own facility is located in Vildbjerg, Denmark and emissions from that location are modelled with Danish energy mixes.

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		
<input type="checkbox"/>	internally	<input checked="" type="checkbox"/> externally



Dr.-Ing. Nikolay Minkov,
(Independent verifier)

Product

Product description/Product definition

This EPD includes the following products depending on application for oil, gas and water pipe systems:

- flanges in stainless steel
- Weld rings in stainless steel
- Collars in stainless steel

The products can come in different dimensions and have slightly varying shapes such as plate flanges, blind flanges, neck flanges, weld rings, collars, etc. The declared products are classified and traded under the following TARif Intégré Communautaire (TARIC) code: 7307 21 00 90.

This EPD specifically excludes the following products:

- products in carbon steel and galvanized carbon steel.
- flange gaskets
- threaded fittings
- valves.

For the placing on the market in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) the following legal provisions apply: 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonization of the laws of the Member States relating to the making available on the market of pressure equipment and the harmonized standards based on these provisions:

- *EN 1092-1:2018, Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 1: Steel flanges*

The CE-marking takes into account the proof of conformity with the respective harmonized standards based on the legal provisions above. For the application and use the respective national provisions apply.

Application

Flanges, weld rings and collars are used to connect different pipes with each other and can be used both for transporting oils and in connection with water. The flanges are usually in the form of an annular disc and are attached to the end of a pipe, where screws and nuts are used to secure the flange and connect the pipes. The different types of flanges include threaded flanges, blind flanges, welding ring flanges, loose flanges, welding neck flanges, welding neck collars.

Technical Data

Flanges, weld rings and collars of stainless steel follow a range of standards in relation to materials, production and technical properties, depending on the type of flanges. The following standards are relevant for INDURA's products declared in this EPD:

- EN1092-1
- ASME B16.5
- DIN2519
- DIN2576
- DIN2642
- DIN86044
- EN10222-5

- EN10272
- EN10028-7
- ASTM A182/A182M
- ASMESA-182/SA182M

Constructional data

Name	Value	Unit
Yield strength	205 - 220	N/mm ²
Tensile strength	520 - 860	N/mm ²
Elongation	min. 40	%
Hardness	140 - 220	HV10
Notched-bar impact value	min. 27 - 40	Joule
Ductility	min. 40	%

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to

- *EN 1092-1:2018, Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 1: Steel flanges.*

Base materials/Ancillary materials

Main material constituents per 1 kg of product in delivery status.

Name	Value	Unit
Stainless Steel	100	%

The flanges, weld rings and collars are produced in stainless steel, following the material norm EN 10222-5.

The main material constituents in the table above are based on the product in delivery status. However, the input of steel is 1.80 kg. Additionally, various packaging materials are also calculated per declared unit. This includes 25*10⁻⁷ kg PVC tape, 0.15 kg cardboard, 0.0011 kg wood EUR pallet, and 0.0027 kg high density polyethylene (HDPE) mesh.

This product/article/at least one partial article contains substances listed in the Candidate List of substances of very high concern for Authorisation (published in accordance with Article 59(10) of the REACH Regulation) (date: 07-09-2023) exceeding 0.1 percentage by mass: **no**.

This product/article/at least one partial article 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: **no**.

Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) Ordinance on Biocide Products No. 528/2012): **no**.

Reference service life

The life cycle of flanges, weld rings and collars is dependent on the respective structural design, use and maintenance. The use phase for steel pipe for oil and gas pipelines is not depicted as they involve maintenance-free and generally durable products. The reference service life is not declared, as the use phase is not included in the scope.

LCA: Calculation rules

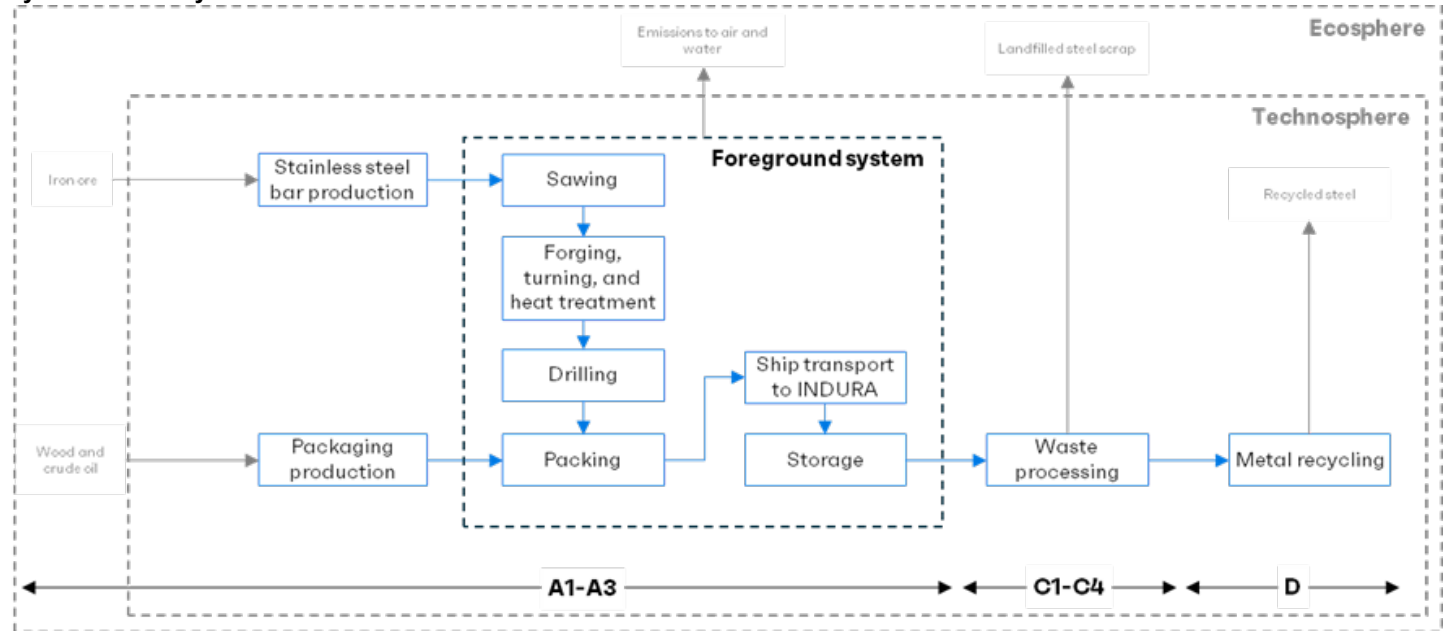
Declared Unit

The declared unit is 1 kg of flanges, weld rings or collars stainless steel, where the highest of each LCIA result is declared on the final EPD.

Declared unit and mass reference

Name	Value	Unit
Declared unit	1	kg
Conversion factor to metric tonne	1000	-
Density	7900	kg/m ³

System boundary



The product stages (A1 and A3) for flanges, weld rings and collars can be seen above. The type of EPD: cradle to gate with Modules C1–C4 and Module D.

The product stage (modules A1-A3) consists of raw material extraction and processing (A1) as well as the transport to the manufacturing location (A2) and activities at the manufacturing facility (A3). In this study, the processes A1-A3 are all included. Wastes and losses of manufacturing processes are included in the unit processes in which they occur according to the polluter pays principle and the modular approach of *EN 15804*.

Practically this means that the metal scrap is modelled so that its waste processing is included in A3 and credited by reducing the input in A1 to the net consumption of steel. However, this credit cannot exceed the input of secondary metals based on a market average. According to the American Iron and Steel Institute (American Iron and Steel Institute, 2012) the average recycled content of steel is 36.9 % when it originates from basic oxygen furnaces. However, for electric arc furnaces, the recycled content is 89.9 %. The sourced materials from Asia that INDURA purchases are most likely originating from basic oxygen furnaces, but the steel market is constrained (all available ferrous metal is generally recycled). For this reason, a total average of the steel recycled content should be applied. It is decided that a conservative approach is used in the calculation and the net input of steel is then modelled as primary (virgin) steel.

At the **end-of-life stage** (module C1-C4), INDURAs products are assumed to be manually disassembled from the piping system in which it has been installed. As a result, no processes have been added to the C1 module. Most customers (>95%) are located in Northern Europe (Scandinavia, Germany and Benelux), thus the transportation distances, technology and waste processing will be modelled accordingly. For the waste processing, it is assumed that the product itself will be recycled as metal. 5 % are considered lost during the recycling process

and are modelled as inert material landfilling. End-of-life treatment of the packaging is not included in the study.

Benefits and loads beyond the system boundaries (module D) include the potential benefits from reuse, recycling and recovery potentials that are outside the scope of the study. This would include all the flows leaving the product system having passed the end-of-waste stage, thereby allowing the use of them as a substitution for primary material in another product system. Thus, the system will get credit for recycling the collected steel. 5 % are considered lost in the sorting process, thus 95 % of the product is credited in module D.

As the steel scrap from production processes is credited in the A1-A3 modules, only the end-of-life product will be credited in module D. The scrap should however first reach functional equivalence to steel, which requires it to be processed using an electric arc furnace (EAF) process. The system is then credited with the avoided production of virgin steel produced using the basic oxygen furnace (BOF) process.

Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product's lifespan: Denmark

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. Furthermore, in order to ensure comparability between EPDs background databases should be consistent. For this declaration, ecoinvent v3.9 has been used.

LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

The biogenic carbon content in the flanges or fittings leaving the factory gate is 0 %. The biogenic carbon content in the accompanying packaging is 46 %, as it mainly consists of cardboard and wood pallet.

Information on describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic carbon content in product	0	kg C
Biogenic carbon content in accompanying packaging	0.07	kg C

Note: 1 kg biogenic Carbon is equivalent to 44/12 kg of CO₂.

Packaging is included and declared in module A3. However, since module A5 is not declared in this EPD, the disposal of the packaging material on the construction site is shown below including waste amounts and the respective waste scenarios. Per declared unit (1 kg) the following packaging wastes occur:

- Tape of PVC: 0.00003 kg assumed for landfilling
- Cardboard box: 0.150 kg assumed for recycling
- EUR-pallet of wood: 0.0011 kg assumed for incineration
- Mesh netting of HDPE: 0.0027 kg assumed for recycling.

End of life (C1-C4)

Name	Value	Unit
Collected separately waste type	1	kg
Recycling	0.95	kg
Landfilling	0.05	kg

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Name	Value	Unit
Collection rate	95	%
EoL amount	0.590	kg

5 % losses are assumed in the sorting and recycling system. This study is a Model EPD where the worst-case scenarios are declared. As a result, module D declares the lowest possible recycling credit when compared across the three main product groups.

Only the net production of steel scrap is credited for, meaning that the consumption of secondary steel in A1 is subtracted before calculating the credit in module D. The loads associated with the processing of steel scrap must have functional equivalence with steel produced from virgin sources. This is done through an electric arc furnace process (EAF) process. The amount of steel produced from the collected scrap steel is then credited with the production of steel from virgin sources, using a basic oxygen furnace (BOF) process.

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	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 kg flanges, weld rings or collars in stainless steel

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Global Warming Potential total (GWP-total)	kg CO ₂ eq	9.11E+00	0	4.18E-03	2.21E-02	3.04E-04	-1.58E+00
Global Warming Potential fossil fuels (GWP-fossil)	kg CO ₂ eq	8.99E+00	0	4.18E-03	2.25E-02	3.04E-04	-1.58E+00
Global Warming Potential biogenic (GWP-biogenic)	kg CO ₂ eq	1.04E-01	0	3.31E-06	-4.64E-04	1.59E-07	4.36E-03
Global Warming Potential luluc (GWP-luluc)	kg CO ₂ eq	1.17E-02	0	2.04E-06	2.72E-05	1.83E-07	-2.93E-04
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC11 eq	8.83E-08	0	9.16E-11	3.54E-10	8.8E-12	-3.43E-08
Acidification potential of land and water (AP)	mol H ⁺ eq	5.06E-02	0	1.95E-05	2.72E-04	2.29E-06	-6.62E-03
Eutrophication potential aquatic freshwater (EP-freshwater)	kg P eq	2.93E-03	0	3.01E-07	1.49E-05	2.53E-08	-7.17E-04
Eutrophication potential aquatic marine (EP-marine)	kg N eq	9.7E-03	0	7.75E-06	6.07E-05	8.8E-07	-1.5E-03
Eutrophication potential terrestrial (EP-terrestrial)	mol N eq	9.7E-02	0	8.29E-05	6.79E-04	9.42E-06	-1.62E-02
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg NMVOC eq	3.04E-02	0	2.89E-05	2.01E-04	3.28E-06	-8.49E-03
Abiotic depletion potential for non fossil resources (ADPE)	kg Sb eq	2.29E-04	0	1.33E-08	1.59E-06	4.28E-10	-1.39E-05
Abiotic depletion potential for fossil resources (ADPF)	MJ	1.04E+02	0	6.07E-02	3.07E-01	7.63E-03	-1.47E+01
Water use (WDP)	m ³ world eq deprived	2.45E+00	0	3.08E-04	5.46E-03	2.37E-05	-2.65E-01

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 kg flanges, weld rings or collars in stainless steel

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Renewable primary energy as energy carrier (PERE)	MJ	2.38E+01	0	9.53E-04	5.36E-02	6.41E-05	-1.02E+00
Renewable primary energy resources as material utilization (PERM)	MJ	2.17E+00	0	0	0	0	0
Total use of renewable primary energy resources (PERT)	MJ	2.6E+01	0	9.53E-04	5.36E-02	6.41E-05	-1.02E+00
Non renewable primary energy as energy carrier (PENRE)	MJ	1.04E+02	0	6.07E-02	3.07E-01	7.63E-03	-1.47E+01
Non renewable primary energy as material utilization (PENRM)	MJ	2.86E-01	0	0	0	0	0
Total use of non renewable primary energy resources (PENRT)	MJ	1.04E+02	0	6.07E-02	3.07E-01	7.63E-03	-1.47E+01
Use of secondary material (SM)	kg	1.13E+00	0	2.7E-05	3.42E-04	1.84E-06	7.82E-01
Use of renewable secondary fuels (RSF)	MJ	1.95E-02	0	3.34E-07	1.72E-05	3.94E-08	-1.2E-04
Use of non renewable secondary fuels (NRSF)	MJ	0	0	0	0	0	0
Use of net fresh water (FW)	m ³	6.61E-02	0	7.73E-06	1.56E-04	7.88E-06	-2.87E-03

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 kg flanges, weld rings or collars in stainless steel

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Hazardous waste disposed (HWD)	kg	2.76E+00	0	4.08E-05	8.24E-04	3.66E-06	-2.33E-01
Non hazardous waste disposed (NHWD)	kg	1.35E+01	0	1.27E-03	5.85E-02	1.1E-04	-2.82E+00
Radioactive waste disposed (RWD)	kg	4.72E-05	0	4.97E-09	1.66E-07	3.2E-10	2.49E-06
Components for re-use (CRU)	kg	0	0	0	0	0	0
Materials for recycling (MFR)	kg	5.14E-01	0	4.57E-07	1E+00	3.42E-08	-9.68E-05
Materials for energy recovery (MER)	kg	1.38E-04	0	2.82E-09	4.63E-08	1.23E-10	-8.47E-06
Exported electrical energy (EEE)	MJ	3.47E-02	0	1E-05	3.75E-04	4.19E-07	1.11E-02
Exported thermal energy (EET)	MJ	1.64E-01	0	2.37E-05	5.76E-05	2.61E-07	-1.37E-02

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 kg flanges, weld rings or collars in stainless steel

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
Incidence of disease due to PM emissions (PM)	Disease incidence	7.22E-07	0	4.11E-10	3.65E-09	5.01E-11	-1.09E-07
Human exposure efficiency relative to U235 (IR)	kBq U235 eq	6.09E-01	0	8.34E-05	2.74E-03	4.8E-06	5.38E-02

Comparative toxic unit for ecosystems (ETP-fw)	CTUe	4.54E+01	0	2.95E-02	2.37E-01	3.54E-03	-2.64E+00
Comparative toxic unit for humans (carcinogenic) (HTP-c)	CTUh	2E-07	0	2.33E-12	4.19E-11	1.37E-13	9.95E-09
Comparative toxic unit for humans (noncarcinogenic) (HTP-nc)	CTUh	2.23E-07	0	4.71E-11	1.75E-09	1.64E-12	-1.17E-08
Soil quality index (SQP)	SQP	6.17E+01	0	4.53E-02	5.87E-01	1.5E-02	-4.63E+00

Disclaimer 1 – for the indicator 'Potential Human exposure efficiency relative to U235'. 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 or 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.

Disclaimer 2 – for the indicators 'abiotic depletion potential for non-fossil resources', 'abiotic depletion potential for fossil resources', 'water (user) deprivation potential, deprivation-weighted water consumption', 'potential comparative toxic unit for ecosystems', 'potential comparative toxic unit for humans – cancerogenic', 'Potential comparative toxic unit for humans - not cancerogenic', 'potential soil quality index'. The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high as there is limited experience with the indicator.

References

Standards

ASTM A182/A182M

Specification for forged or rolled alloy and stainless steel pipe flanges, forged fittings, and valves and parts for high temperature service

ASME B16.5

B16.5 - 2020, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24, Metric/Inch Standard.

ASMESA-182/SA182M

Specification for forged or rolled alloy and stainless steel pipe flanges, forged fittings, and valves and parts for high temperature service

DIN 2519

German norm for steel flanges

DIN 2576

German norm for plate flanges

DIN 2642

German norm for loose plate flanges

DIN 86044

German norm for plate flanges

Documents provided by the Institut Bauen und Umwelt e.V.:

Product Category Rules for Building-Related Products and Services: Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report according to EN 15804+A2:2019 version 1.3

Product Category Rules Part B: Requirements on the EPD for Steel pipes for pressure applications 01/08/2021 (version 1).

EN 15804

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

EN ISO 14040/44

EN ISO 14040:2006, Environmental management – Life cycle assessment - Principles and framework; English version EN ISO 14040:2006 EN ISO 14044:2006, Environment Management – Life Cycle Assessment – Requirements and Instructions; English version EN ISO 14044:2006.

EN 1092-1

EN 1092-1:2018,

Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 1: Steel flanges.

EN 10028-7

Flat products made of steels for pressure purposes - Part 7: Stainless steels

EN10222-5

Steel forgings for pressure purposes-Part 5: Martensitic, austenitic and austenitic - ferritic stainless steels

EN 10272

Stainless steel bars for pressure purposes

ISO 14025

EN ISO 14025:2011, Environmental labels and declarations — Type III environmental declarations — Principles and procedures.

Further references

American Iron and Steel Institute. (2012).

CSSBI. Steel Takes LEED® with Recycled Content. From <https://cssbi.ca/> [access on 10-12-2022]

Candidate List of Substances of Very High Concern

<https://echa.europa.eu/candidate-list-table> [access on 12-06-23]

EcolInvent 3.9

EcolInvent database version 3.9, cut-off, EN15804 model. LCIA methodology EF v3.1 EN15804. Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., and Weidema, B., 2016. The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, [online] 21(9), pp.1218–1230. Available at: [Accessed 10-12-2022].

IBU 2021

Institut Bauen und Umwelt e.V.: General Instructions for the EPD programme of Institut Bauen und Umwelt e.V., Version 2.0, Berlin: Institut Bauen und Umwelt e.V., 2021 www.ibu-epd.com

INDURA

<https://www.indura.com/products> [access on 10-12-22]

Ordinance on Biocide Products No. 528/2012

Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products Text with EEA relevance.

<http://data.europa.eu/eli/reg/2012/528/oj> [access on 12-06-23]

SimaPro 2023

LCA Software; PRé Sustainability, Version 9.5

TARIC

TARIC, the integrated Tariff of the European Union, is a multilingual database integrating all measures relating to EU customs tariff, commercial and agricultural legislation. Link to database: https://ec.europa.eu/taxation_customs/dds2/taric/ [access on 12-06-23]



Publisher

Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com



Programme holder

Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com



Viegand Maagøe

Author of the Life Cycle Assessment

Viegand Maagøe
Nørre Farimagsgade 37
1364 Copenhagen
Denmark

+4533349000
info@viegandmaagoe.dk
www.viegandmaagoe.dk/en



Owner of the Declaration

INDURA
Grønlandsvej 1
7480 Vildbjerg
Denmark

+45 97133244
salg@indura.dk
www.indura.dk/