Carbon Footprint Declaration No. 335/2022

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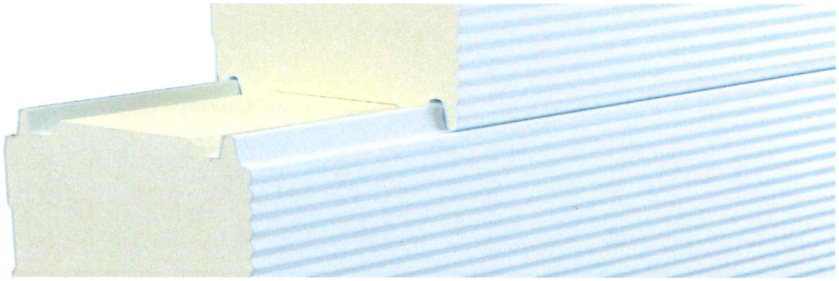
ARPANEL sandwich panels with PIR insulation core



EPD Program Operator:

Instytut Techniki Budowlanej ITB [1]
Address: Filtrowa 1, 00-611 Warsaw, Poland
Website: www.itb.pl
Contact: Michał Piasecki, Ph.D. D.Sc. Eng.
m.piasecki@itb.pl, energia@itb.pl

Owner of the EPD:

ARPANEL - płyty warstwowe
Adamietz Sp. z o.o.
Address ul. Braci Prankel 1
Strzelce Opolskie
Postcode: 47-100
Telephone number: +48 77 463 00 55
Website: https://arpanel.pl/
E-mail address: biuro@arpanel.pl

ITB is the verified member of The European Platform for EPD program operators and LCA practitioner www.eco-platform.org

Basic information

This declaration is the Carbon Footprint Declaration (CFD) based on ISO 14067:2018 Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification and verified according to ISO 14025 by an external auditor. It contains the information on the carbon impacts as GWP indicator of the declared construction materials on the environment. Their aspects were verified by the independent body according to ISO 14025. Basically a comparison or evaluation of CFD data is possible only if all the compared data were created according to ISO 14067:2018.

Life cycle analysis (LCA): A1-A3, C1- C4 and D in accordance with EN 15804 (Cradle to Gate with options)
The year of preparing the EPD: 2022
Product standard: EN 14509
Service Life: Under not aggressive and stable conditions RSL is predicted to be 45 years
PCR: ITB-PCR A (PCR based on EN 15804)
Functional unit: 1 m^2
Reasons for performing LCA: B2B
Representativeness: Polish product, year 2021

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[1] *ITB is an accredited and notified body for certification of products (ID number 1488) - conducts certification activities within the scope of certification of products and construction services and the factory production control by acting in accordance with the requirements of the 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, the PN-EN ISO/IEC 17065 standard and having an accredited research laboratory in accordance with PN-EN ISO/IEC 17025 (accreditation number AB 023).*

MANUFACTURER

Figure 1. A view of the ARPANEL production hall in Strzelce Opolskie (Poland).

Arpanel sandwich panels production facility is located in Strzelce Opolskie, Poland. Both produced types of Arpanel sandwich panels, with mineral wool and PIR cores, can be produced on the same, so-called "combi" line.

In 2013 the production of insulation sandwich panels for roofs and walls of various buildings constructed with steel and reinforced concrete started.

Flow chart in Figure 2 presents the continuous production process of sandwich panels. Adamietz focuses on providing products which meet the high requirements of investors, users, and designers of modern industrial, commercial, and public buildings.

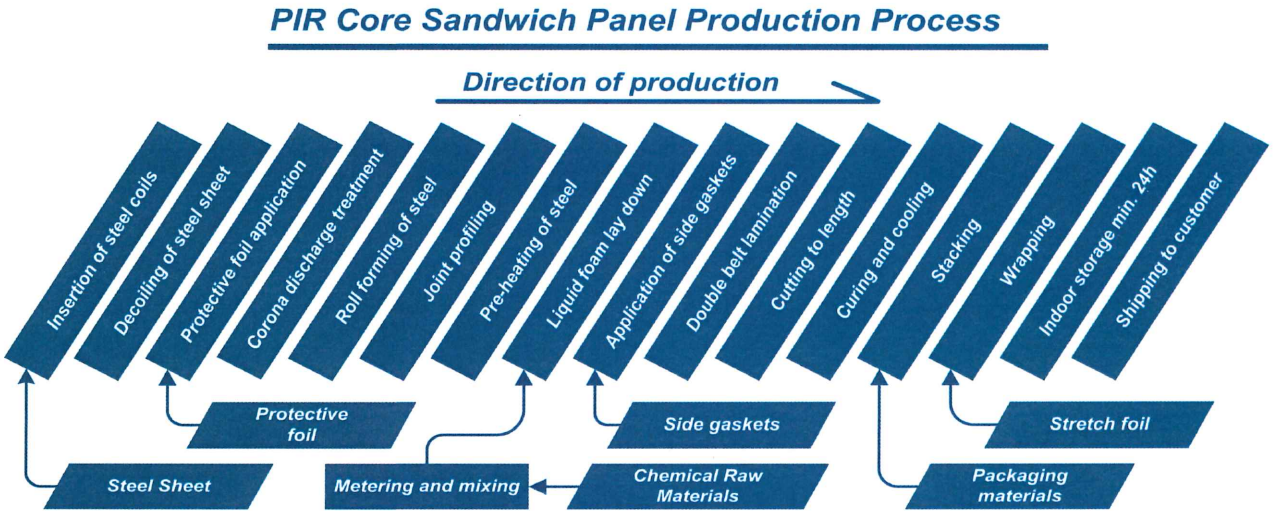

Figure 2. A production process of sandwich PIR panels.

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PRODUCT DESCRIPTION

Wall panels

Sandwich panels are made of the rigid polyisocyanurate (PIR) foam core (density 40 kg/m^3) in steel cladding. Wall sandwich panels with PIR core in steel facing are commonly used building material for building industrial, commercial, cubature, office, sports, agricultural, and public buildings. Sandwich panels are also used to build partition walls, ceilings, and other partitions in various types of building. Roof sandwich panels (external surface) are used to make various types of roof with a small or medium inclination angle. Thanks to the proper profiling of the locks, ARPANEL roof sandwich panels have total tightness against air, steam, and rain infiltration. Roof panels are used as roofing material for production buildings, shopping centers, warehouses, and agricultural-industry buildings. The basic technical data concerning the range of manufactured sandwich wall and roof panels with PIR core are presented in the Figure 3.

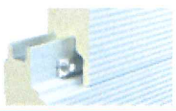
Types of ARPANEL sandwich panels with PIR insulation core				
Type of panel	wall			roof
Name	ARPANEL S PIR	ARPANEL SU PIR	ARPANEL CH PIR	ARPANEL D PIR
				
Insulation core	Polyisocyanurate foam PIR			
Fastening system	standard	hidden	standard	
Thickness [mm]	40 60 80 100	60 80 100 120 140	120 140 160 200	40/80 60/100 80/120 100/140 120/160 160/200
Panel width [mm]	1000 1100 1150	1000	1000 1100 1150	1000
Thickness of cladding external/internal[mm]	external 0,4 - 0,7 mm | internal 0,4 – 0,7 mm			
External profiling	Micro 8 Micro 14 Micro 20 Linear Smooth			Trapezoid
Internal profiling	Linear Smooth Micro 20			

Figure 3. The basic product type technical data concerning the range of manufactured sandwich panels.

TECHNICAL PROPERTIES and CERTIFICATES

All technical properties of PIR sandwich panels in the field of fire reaction, fire resistance, flame propagation, thermal physics, acoustic insulation, corrosion resistance, statics are detailed in the technical catalogs which can be downloaded at https://arpanel.eu/download. Sandwich panels are manufactured in accordance with EN 14509, CE marked and possess the Declaration of Performance.

APPLICATIONS

Sandwich panels are constructed from materials which consist of construction elements (external steel facings) and construction – insulation layers (core of the panel). The idea of sandwich panels is permanent connection construction of facings with core on whole surface in order to get the static

collaboration among them. The application types for the product may be used: roofs and roof cladding, external walls and wall cladding, walls (including partitions) and ceilings within the building envelope.

LIFE CYCLE ASSESSMENT (LCA) – general rules applied

Allocation

Carbon allocation for production A1-A3 is done on a production mass basis. All impacts from raw materials extraction and production (including: steel profile faces, polyols, MDIs, catalyst KX, n-pentane, paper gaskets, packaging, energy carriers and water) are allocated in A1 module (resources production). 100% of impacts from line production were inventoried and were allocated to the panels production. Utilization of packaging material (PE, PP, styrofoam) was taken into consideration. Module A2 (transport to factory) includes transport of raw materials such as faces, chemicals, additives and ancillary materials from their suppliers to the manufacturing plant. Municipal wastes of factory were allocated to module A3 (factory production). Energy supply was inventoried for whole factory and 100% was allocated to the PIR based sandwich panels production. Emissions in the factory were estimated by using the national carbon/energy conversion factors (KOBiZE) and were allocated to module A3.

System limits

The life cycle analysis of the declared products covers "Product Stage", A1-A3, C1-C4 and D modules (Cradle to Gate with options) accordance with ISO 14067, EN 15804 and ITB PCR A. The input materials and energy consumption inventoried in factories and were included in calculation. In the assessment, all significant parameters from gathered production data are considered, i.e. all material used per formulation, utilized thermal energy, internal fuel and electric power consumption. It is assumed that the total sum of omitted processes does not exceed 5% of all impact categories. In accordance with EN 15804, machines and facilities (capital goods) required for and during production are excluded, as is transportation of employees.
The reference service life of product (RSL) is not relevant in this CFD since the use stage of the building is not taken into consideration. Sandwich panels consist of insulation core and steel facings. Expected service life of sandwich panels is a combination of these components. RSL for core material is foreseen to be greater than 50 year. Durability of steel facings strongly depends on the environment and the final use of sandwich panels. Nevertheless, under not aggressive (class C1 – C3 and A1 - A2) and stable conditions RSL for ARPANEL sandwich panels is predicted to be 45 years.

A1 and A2 Modules: Raw materials supply and transport

In order to produce a sandwich panel, core insulation material and facings are required (0.5/0.5 mm). In the case of ARPANEL PIR sandwich panels family a core material is a polyisocyanurate foam obtained in a controlled chemical reaction during production process. A vast majority of liquid components, necessary for chemical reactions, are sourced from inventoried foreign suppliers Hot-dip galvanised and colour coated steel sheets are being used as facings. Steel sheet coils are being sourced at domestic and foreign steel mills. Main two largest steel delivery producers provide 85% of steel profiles. ARPANEL panels, remaining ancillary materials such protective films, as well as all packaging materials are supplied by local producers. The transport to the factory has been fully inventoried (LCI questionnaire), taking into account the number of deliveries, type of vehicles, the size of the delivery and the distance from the manufacturer to the factory for all materials and raw materials.

A3: Production

ARPANEL sandwich panels, regardless insulation core used, are being produced in a continuous production process. Necessary stops are required for change overs between panel types. Production process itself (PIR and MiWO) can be divided into several stages (figure 4):

1. **Profiling of facings material**

During this stage, designated steel coils are being unwind. One of steel sheets will be used as a façade facing, while the other one as internal facing. The protective foil is applied to prevent from unwanted coating defects, that can appear during production or transport. Then internal sides of each steel sheets are being treated by corona discharge to improve adhesion process at the subsequent foaming

(in the case of PIR core) or bonding (in the case of mineral wool) process. At the end of this stage, designed surface's profiling and the side profiling (to form panel's joint) is taking place.

2. **Foaming or forming of the insulation core**
Depending on the produced type of sandwich panels the insulation core is either foamed (in case of PIR) or formed (in case of mineral wool). These two interchangeable processes are taking place on the same production line.

2.1. **Foaming**
PIR insulation core material is being formed as a product of chemical reactions. Main components are polymeric isocyanate and polyols. To control reaction speed catalysts are being used. Pentane is used as a physical blowing agent, but due to its very low thermal conductivity, is also responsible for superior heat insulation properties of panels with PU/PIR core. All components, according to formulation, are being precisely dosed and mixed at high pressure in a liquid form. Such a reactive mixture is being evenly distributed across internal side of profiled façade facing. Foaming process starts and two facings are reaching double belt laminator, where expanding chemical mixture fills volume with very fine cells structure foam. Double belt laminator ensure dimension (thickness and width of sandwich panel), as well as necessary conditions for foam to harden.

2.2. **Forming**
Mineral wool is being deliver to production line in slabs, which are being transported one by one and cut by multi saw to form lamellas of desired height. Next, lamellas are being turned by 90 degrees (fibres must be perpendicular to facings) and arrange by pusher to form continuous core between metal facings. Then, polyurethane, 2-component adhesive is being applied between metal facings and core material. Double belt laminator ensure dimension (thickness and width of sandwich panel), as well as necessary conditions for adhesive to harden and permanently connect facings to mineral wool core.

3. **Cutting to length and cool down**
At this stage, panels are being cut to length, according to customer request, by flying saw synchronised with production line speed. Next, panels are being transported into a cooling buffer, where need to spend relevant time to reach temperature stability.

4. **Packaging**
In the end of the process panels are stacked to form a parcel, which is subsequently wrapped with foil. Next ready parcels need to stabilise for 48 hours (for PIR) or 24h (for mineral wool) indoors warehouse. Finally, parcels are being load on trucks and deliver to customer.

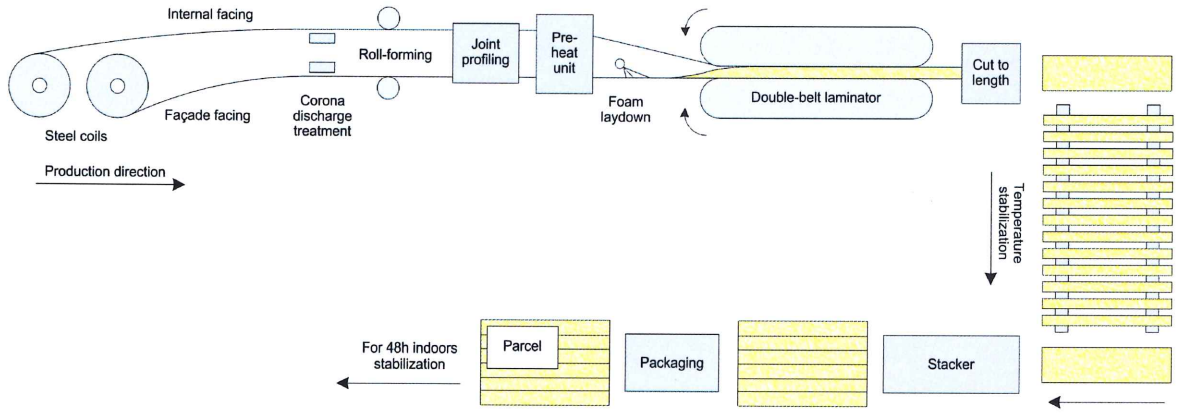


Figure 4. A scheme of production process of sandwich panels with PIR core.

C1 – C4: End of life

The end of life scenario for a sandwich panel with PIR core is provided in Table 1. The product is disassembled using a mechanical jack and electric tools. It is assumed that at the end of life the transport distance from the product deconstruction place to waste processing (C2) is 50 km on > 16 t loaded lorry with 75% capacity utilization and fuel consumption of 35 l per 100 km.

Table 1. End of life scenario (C modules) for a sandwich panel with PIR core

Parameter	Contribution
Collection rate	100%
Reuse	10%
Recycling steel	98% of cladding
Landfilling steel	2% of cladding

Incineration of PIR	50% of PIR core
Landfilling PIR	50% of PIR core

D: Re-use, recovery, recycling potential

Benefits beyond the system boundary were calculated for steel cladding using a net scrap formulation proposed by World Steel Association in *Life cycle inventory methodology report (*2017) where the net scrap is determined as a difference between the amount of steel recycled at end-of-life and the scrap input from previous product life cycle. 10% of "reuse benefit" is calculated for A1-A3 values of sandwich panel production.

Data collection period

The data for manufacture of the declared products refer to year 2021. The life cycle assessments were prepared for Poland as reference area.

Data quality

The values determined to calculate the LCA originate from LCI verified inventory data provided by ARPANEL.

Assumptions and estimates

The impacts of the sandwich panels were aggregated using volume of production. Impacts were inventoried and calculated for all products of the sandwich panels.

Calculation rules

LCA was done in accordance with ISO 14067 and ITB PCR A document.

Databases

The data for the processes come from the following databases: Ecoinvent v.3.8 (polyol, MDI, catalyst KX, n-pentane, gasket, packaging, water), specific EPDs (steel profile producers), KOBIZE(national energy carriers: electricity, ON, natural gas and LPG). Specific data quality analysis was a part of external audit. Characterization factors are CML ver. 4.2 version.

LIFE CYCLE ASSESSMENT (LCA)

Declared/functional unit

The declaration refers to functional unit (FU) – 1 m^2 of the sandwich panels (cladding: 2 x 0.5 mm) manufactured by ARPANEL with selected thickness.

Table 2. System boundaries for the environmental characteristic of the sandwich panels with PIR core.

Environmental assessment information (MNA – Module not assessed, MD – Module Declared, INA – Indicator Not Assessed)																
Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport to construction site	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction 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
MD	MD	MD	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MD	MD	MD	MD	MD

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Carbon Fooprint Results

Table 3. Carbon footprint of 1 m^2 of ARPANEL sandwich panels with PIR insulation core (40 mm, 40 kg/m^3)

Environmental impacts: (FU) 1 m^2							
Indicator	**Unit**	**A1- A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	kg CO_2 eq.	2.66E+01	1.57E-01	7.90E-02	3.58E+00	1.39E-02	-3.06E+00

Table 4. Carbon footprint of 1 m^2 ARPANEL sandwich panels with PIR insulation core (60 mm)

Environmental impacts: (FU) 1 m^2							
Indicator	**Unit**	**A1- A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	kg CO_2 eq.	2.84E+01	1.57E-01	7.90E-02	5.35E+00	1.51E-02	-3.27E+00

Table 5. Carbon footprint of 1 m^2 ARPANEL sandwich panels with PIR insulation core (80 mm)

Environmental impacts: (FU) 1 m^2							
Indicator	**Unit**	**A1- A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	kg CO_2 eq.	3.02E+01	1.57E-01	7.90E-02	7.11E+00	1.64E-02	-3.47E+00

Table 6. Carbon footprint of 1 m^2 ARPANEL sandwich panels with PIR insulation core (100 mm)

Environmental impacts: (FU) 1 m^2							
Indicator	**Unit**	**A1- A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	kg CO_2 eq.	3,20E+01	1.57E-01	7.90E-02	8.88E+00	1.76E-02	-3.68E+00

Table 7. Carbon footprint of 1 m^2 ARPANEL sandwich panels with PIR insulation core (120 mm)

Environmental impacts: (FU) 1 m^2							
Indicator	**Unit**	**A1- A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	kg CO_2 eq.	3.38E+01	1.57E-01	7.90E-02	1.06E+01	1.88E-02	-3.85E+00

Table 8. Carbon footprint of 1 m^2 ARPANEL sandwich panels with PIR insulation core (140 mm)

Environmental impacts: (FU) 1 m^2							
Indicator	**Unit**	**A1- A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	kg CO_2 eq.	3.56E+01	1.57E-01	7.90E-02	1.24E+01	2.00E-02	-4.05E+00

Table 9. Carbon footprint of 1 m^2 ARPANEL sandwich panels with PIR insulation core (160 mm)

Environmental impacts: (FU) 1 m^2							
Indicator	**Unit**	**A1- A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	kg CO_2 eq.	3.73E+01	1.57E-01	7.90E-02	1.42E+01	2.12E-02	-4.25E+00

Table 10 Carbon footprint of 1 m^2 ARPANEL sandwich panels with PIR insulation core (200 mm)

Environmental impacts: (FU) 1 m^2							
Indicator	**Unit**	**A1- A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	kg CO_2 eq.	4.09E+01	1.57E-01	7.90E-02	1.77E+01	2.36E-02	-4.66E+00

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Verification

The process of verification of this EPD is in accordance with ISO 14025 and ISO 21930. After verification. this EPD is valid for a 5-year-period. EPD does not have to be recalculated after 5 years. if the underlying data have not changed significantly.

The basis for LCA analysis was ISO 14067:2018, EN 15804 and ITB PCR A
Independent verification corresponding to ISO 14025 (subclause 8.1.3.) [X] external [ ] internal
External verification of EPD: Ph.D. Eng. Halina Prejzner LCA, LCI audit and input data verification: Ph.D. Eng. Michał Piasecki. m.piasecki@itb.pl Verification of LCA: Ph.D. Eng. Justyna Tomaszewska. j.tomaszewska@itb.pl

Basically. a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to ISO 14067 and the building context. respectively the product-specific characteristics of performance. are taken into account.

Normative references

- PU Europe - the European association of PU insulation manufacturers (www.pu-europe.eu)
- ISO 14067:2018. Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification
- ITB PCR A General Product Category Rules for Construction Products
- ISO 14025:2006. Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
- ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 15686-1:2011 Buildings and constructed assets – Service life planning – Part 1: General principles and framework
- ISO 15686-8:2008 Buildings and constructed assets – Service life planning – Part 8: Reference service life and service-life estimation
- EN 15804:2012+A1:2013+A2:2019 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
- PN-EN 15942:2012 Sustainability of construction works – Environmental product declarations – Communication format business-to-business
- KOBiZE Wskaźniki emisyjności CO_2, SO_2, NO_x, CO i pyłu całkowitego dla energii elektrycznej, 2021
- PN-EN 13165+A2:2016-08 Wyroby do izolacji cieplnej w budownictwie -- Wyroby ze sztywnej pianki poliuretanowej (PU) produkowane fabrycznie - Specyfikacja

dr hab. inż. Michał Piasecki

KIEROWNIK
Zakładu Fizyki Cieplnej, Akustyki i Środowiska
dr inż. Agnieszka Winkler-Skalna

Building Research Institute
00-611 Warszawa, ul. Filtrowa 1

Instytut Techniki Budowlanej
00-611 Warsaw, Filtrowa 1

Thermal Physics, Acoustics and Environment Department
02-656 Warsaw, Ksawerów 21

CERTIFICATE № 335/2022
of CARBON FOOTPRINT DECLARATION

Products:

ARPANEL sandwich panels with PIR core

Manufacturer:

ARPANEL - płyty warstwowe Adamietz Sp. z o.o.

ul. Braci Prankel 1, 47-100 Strzelce Opolskie, Poland

confirms the correctness of the data included in the development of Carbon Footprint Declaration and accordance with the requirements of the standard

ISO 14067:2018

Greenhouse gases
Carbon footprint of products
Requirements and guidelines for quantification

This certificate, issued for the first time on 1st June 2022 is valid for 3 years or until amendment of mentioned Environmental Declaration

Head of the Thermal Physic, Acoustics and Environment Department
Agnieszka Winkler-Skalna, PhD

INSTYTUT TECHNIKI BUDOWLANEJ

Deputy Director for Research and Innovation
Krzysztof Kuczyński, PhD

Warsaw, June 2022